

EXHIBIT B

To Defendants Shell Oil Company and Shell Oil Products
US, Inc.'s Joinder in Defendant United States Steel's
Motion to Exclude Plaintiff's Expert Robert Herrick

THE CIRCUIT COURT FOR
BALTIMORE CITY

Estate of James Coppage,

Plaintiff,

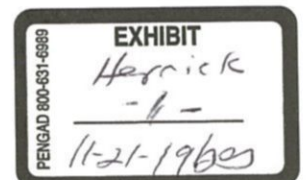
VS.

United States Steel Corporation, et al.,

Defendants.

No. 24C18005920

EXPERT REPORT OF
ROBERT F. HERRICK, Sc.D., CIH, FAIHA



BACKGROUND

James Coppage was born on August 3, 1942, and grew up in Baltimore, Maryland.¹ He attended one year at Mergenthaler Vocational Technical High School.² Sometime thereafter, during a period of 2 years, he worked for 2 plumbing outfits and 3 gas stations—he worked 40 hours a week at the gas stations.³ While working at the Shell gas station during the summer months in 1960, Mr. Coppage reported pumping gas, greasing cars, and fixing flats, but was not a mechanic; he worked 5 days a week.⁴

Mr. Coppage started working for the newspaper printing industry in September 1960 and worked at various newspapers until 2006 when he retired.⁵ During this 46-year period, he was always part of the union—Graphic Communications International Union and Teamsters.⁶ According to his deposition and Social Security records, Mr. Coppage had the following series of jobs in the Newspaper printing industry as identified in Table 1 along with the general tasks he reported doing, as available from his deposition. He was typically given two, 15-minute breaks and one-half hour lunch for the shifts he worked at the various papers.⁷

Table 1 Summary of James Coppage Employment History in the Newspaper Printing Industry						
Employer	Job Title	Duration	Production	Daily Cleaning Press	Daily Cleaning Ink Buckets	Maintenance Cleaning
Baltimore Sun	Junior Pressman	1960 – 1965	Yes	Yes	Yes	Yes
Boone Press Inc.	Junior Pressman	1961 – 1966	Yes	No	No	No
Twentieth Century Printing Company	Junior Pressman	1963	Yes	No	No	No
Baltimore Sun	Apprentice	1965 – 1969	Yes	Yes	Yes	Yes
News-American	Apprentice	1965 – 1969	Yes	Yes	No	Yes
Alco-Gravure	Apprentice	1965 – 1969	Yes	Yes	No	Yes
Alco-Gravure	Journeyman Pressman	1969 – 1998	Yes	Yes	No	Yes
Baltimore Sun	Journeyman Pressman	1999 – 2000	Yes	Yes	Yes	Yes
Wallstreet Journal	Journeyman Pressman	1999 – 2000	Yes	Yes	No	Yes
Baltimore Sun	Journeyman Pressman	2000 – 2006	Yes	Yes	No	Yes

In addition to the testimony of Mr. Coppage, additional details for this report were also extracted from the deposition of Robert Stallings—a former co-worker of Mr. Coppage at the Baltimore Sun, Alco-Gravure, and News-American.⁸ Such information was used to supplement or

¹ Deposition of James Coppage, March 11, 2019, Page 10-11.

² Deposition of James Coppage, March 11, 2019, Page 13.

³ Deposition of James Coppage, March 11, 2019, Page 82-83.

⁴ Deposition of James Coppage, March 11, 2019, Page 279-281.

⁵ Deposition of James Coppage, March 11, 2019, Page 16.

⁶ Deposition of James Coppage, March 11, 2019, Page 152-153.

⁷ Deposition of James Coppage, March 11, 2019, Page 145-147.

⁸ Deposition of James Coppage, March 11, 2019, Page 264-265, 267-268.

corroborate that which was already provided by Mr. Coppage or fill-in missing information from his testimony.

MR. COPPAGE'S EMPLOYMENT HISTORY IN THE NEWSPAPER PRINTING INDUSTRY

Junior Pressman: Baltimore Sun, September 1960 – September 1965

Mr. Coppage started working for the Baltimore Sun as a Junior Pressman in September 1960 until September 1965 at which point, he started his apprenticeship.⁹ During this time as a Junior Pressman, he worked 44 hours a week on the night shift.¹⁰ He reported that during the summertime, he would reportedly sit outside of the plant during break time.¹¹

Job Tasks as a Junior Pressman at the Baltimore Sun

Regarding typical tasks on a given day as a Junior Pressman, Mr. Coppage reported, "some days you're on the press, some days you could be the ink boy. You could be extra and be on cleanup."¹² According to Mr. Coppage's testimony, Junior Pressmen did the most cleaning; he reported, "they got the worst of it."¹³ Mr. Coppage reported that as a Junior Pressman, he always wore gloves when using solvents; he described the gloves as being rubber and reaching halfway between the wrists and elbow.¹⁴

General Work Around the Printing Press

As a Junior Pressman at the Baltimore Sun, it was generally his job to be there and working around the press.¹⁵ Mr. Coppage described his duties as a Junior Pressman: he would carry the lead plates and set them around the press where they belonged and generally kept the press cleaned up since paper would break on the press; at the end of his shift, he would "blow-out" or clean up paper dust.¹⁶ He reported that there would be mist coming out of the presses, "it's actually the ink, but it's in the form of a mist because you're running fast. You're running 50,000 papers an hour."¹⁷ He reported that they made paper hats to keep the ink off their heads.¹⁸ This ink misting off the press was a daily occurrence during the time he was a Junior Pressman in the old press room before the Sun went offset in 1993.¹⁹

⁹ Deposition of James Coppage, March 11, 2019, Page 12-13, 17.

¹⁰ Deposition of James Coppage, March 11, 2019, Page 80-81.

¹¹ Deposition of James Coppage, March 11, 2019, Page 39.

¹² Deposition of James Coppage, March 11, 2019, Page 20.

¹³ Deposition of James Coppage, March 11, 2019, Page 114.

¹⁴ Deposition of James Coppage, March 11, 2019, Page 273-274.

¹⁵ Deposition of James Coppage, March 11, 2019, Page 41-42.

¹⁶ Deposition of James Coppage, March 11, 2019, Page 19.

¹⁷ Deposition of James Coppage, March 11, 2019, Page 37.

¹⁸ Deposition of James Coppage, March 11, 2019, Page 37-38.

¹⁹ Deposition of James Coppage, March 11, 2019, Page 38-39.

Helping Refill Color Ink Fountains on the Press and Cleaning up Ink Buckets

As a Junior Pressman, Mr. Coppage would also serve as “the ink boy.” Since color inks would be manually refilled in the press, he would be tasked with bringing 2 to 3-gallon buckets of the color inks and setting them around the press so that the pressman could refill the fountains on the press.²⁰ This was not an everyday task and occurred “time to time” since most of the printing during this time was black and white.²¹

Mr. Coppage described how the color inks were taken to the press: at the end of the pressroom there were 55-gallon drums with different color inks that he would use to fill smaller 2- to 3-gallon buckets and carry them to the press and set them at the right place for the pressman to use; as these smaller buckets became empty, he would go back and refill; there could be multiple buckets to refill throughout the day.²² He also had responsibility for cleaning the ink buckets: he would empty out any left-over ink back into the 55-gallon drum and then take the bucket into the ink room, which had a big tank containing solvent and a bubbler to soften up the ink; he would put the bucket in the tank and with gloves on he would wash it out.²³ On the days he did have responsibility for filling the ink; he reported spending 2 hours cleaning the buckets.²⁴

The ink buckets were cleaned inside a metal square tank, which he approximated to be 4 by 4 feet with probably 2.5 feet of solvent in it; he would get the solvent which was used inside the tank from 55-gallon drums that he would then use a 5-gallon bucket to transfer into the cleaning tank.²⁵ He didn’t recall how the 55-gallon drum got upstairs to where the solvent tank was located but reported using “little wagons” to pull the 5-gallon bucket into the ink room.²⁶ When he would be standing at the solvent tank, he reported that his face would be hanging over the tank and that the solvent had an odor, which he described as a “petroleum smell.”²⁷

Cleaning with Solvent: Ink Rails on the Press, Press Framework and Ink Spills

According to Mr. Coppage’s testimony, the ink rail would normally skim the ink roller on the press, but if the ink rail wasn’t set correctly, there would be a mess and he would have to put on coveralls and go in the press and clean them with rags and a solvent.²⁸ This was the same solvent he used to clean the ink buckets in the ink room.²⁹ On the days he washed the ink rails, he reported spending 5-6 hours washing them; he would have to climb into the press and wear 2

²⁰ Deposition of James Coppage, March 11, 2019, Page 20, 25.

²¹ Deposition of James Coppage, March 11, 2019, Page 20.

²² Deposition of James Coppage, March 11, 2019, Page 20-21, 47-48.

²³ Deposition of James Coppage, March 11, 2019, Page 21-22, 24.

²⁴ Deposition of James Coppage, March 11, 2019, Page 22.

²⁵ Deposition of James Coppage, March 11, 2019, Page 23-24.

²⁶ Deposition of James Coppage, March 11, 2019, Page 23-24.

²⁷ Deposition of James Coppage, March 11, 2019, Page 24-25, 31.

²⁸ Deposition of James Coppage, March 11, 2019, Page 27-29.

²⁹ Deposition of James Coppage, March 11, 2019, Page 29.

pairs of coveralls.³⁰ He would wash the ink rails about once a week during this 5-year timeframe as a Junior Pressman.³¹

Mr. Coppage reported cleaning the framework and the frame of the press with the same solvent he used for the other cleaning tasks and a rag.³² He would also wear gloves during this process and spent 4 or 5 hours cleaning the rollers and the framework with another junior pressmen since there was a lot of rollers and a lot of framework.³³ He didn't know how much solvent he would have used to do this but reported, "whatever it took."³⁴ Regarding how often he would clean the rollers and frame, he reported that it varied anywhere from twice in one week, once a month or that someone else might get the job.³⁵ In addition, Mr. Coppage also cleaned up ink spills with the solvent and a rag.³⁶

Junior Pressman: Boone Press Inc., 1961 – 1966

Mr. Coppage reported working as a Junior Pressman at Boone Press for minimal time from 1961-1966, which he reported was a small shop that published for the catholic archdiocese.³⁷ He didn't recall using solvents at Boone Press.³⁸ It's unclear how many hours Mr. Coppage would have worked at this paper throughout this 5-year timeframe, but his social security statement indicates a total earning of about \$486 for this 5-year timeframe.

Junior Pressman: Twentieth Century Printing Company, 1963

In 1963, Mr. Coppage was a Junior Pressman for "a couple of hours" at Twentieth Century Printing Company, which published food store circulars.³⁹ He reportedly didn't use any solvents at this employer.⁴⁰ It's unclear how many hours Mr. Coppage would have worked at this paper, but his social security statement indicates minimal time based on his earnings for the year, \$104.

Apprentice: Baltimore Sun, News-American and Alco-Gravure, September 1965 – June 1969

Mr. Coppage worked as an apprentice for 4 years from September 1965 to June 1969. During this 4-year apprenticeship, he rotated between working at the Baltimore Sun, News-American, and the Alco-Gravure.⁴¹ He described how the rotation worked: there was 4 months of day work at the

³⁰ Deposition of James Coppage, March 11, 2019, Page 30.

³¹ Deposition of James Coppage, March 11, 2019, Page 31.

³² Deposition of James Coppage, March 11, 2019, Page 31-32, 35.

³³ Deposition of James Coppage, March 11, 2019, Page 32-33, 35.

³⁴ Deposition of James Coppage, March 11, 2019, Page 35.

³⁵ Deposition of James Coppage, March 11, 2019, Page 35-36.

³⁶ Deposition of James Coppage, March 11, 2019, Page 38.

³⁷ Deposition of James Coppage, March 11, 2019, Page 257.

³⁸ Deposition of James Coppage, March 11, 2019, Page 258.

³⁹ Deposition of James Coppage, March 11, 2019, Page 259.

⁴⁰ Deposition of James Coppage, March 11, 2019, Page 259.

⁴¹ Deposition of James Coppage, March 11, 2019, Page 14, 42.

Baltimore Sun, 4 months of night work, 8 straight months at the News-American and then he came back to the Sun for 4 months; followed by Alco for 4 months and back to the Sun. Then in December 1968, he became what was called a permit journeyman since he was still considered an apprentice but was moved up to journeyman scale to fulfill needs.⁴² He worked at the Sun until June of 1969.⁴³ Mr. Coppage typically worked 5 days a week but reported that he made overtime almost every week if they needed extra journeymen during one of his nights off.⁴⁴ As an apprentice, he would be assigned to a journeyman for the day—he would essentially do the work of the journeyman under supervision and correction.⁴⁵

Job Tasks as an Apprentice at The Baltimore Sun, News-American, and Alco-Gravure

General Work Around the Printing Press

Apprentices were assigned to journeyman pressman to learn the printing craft as well as do all the functions that a journeyman pressman would do.⁴⁶ Both the News-American and Baltimore Sun had the letterpress; Mr. Coppage's job duties were essentially the same at both places.⁴⁷ As an apprentice at the News-American and the Sun, he described his daily duties involving running of the press all day—he would set the press up when he came in the morning, which involved leading sheets of paper through the rollers of the superstructure and then putting the lead plates on a press; he would shut down at different times and change plates when the stories changed; he was also responsible for managing the ink box on the press to set the amount of ink required for each column.⁴⁸ This is consistent with the recollection of Robert Stallings.⁴⁹ If the press went down, it was also Mr. Coppage's job to lead the sheet back through all the rollers.⁵⁰

Mr. Coppage would also clean the cylinders with a rag that the lead plates with the raised letters would get attached to.⁵¹ He reported that although there was misting of ink from the presses at News-American, it was "not nearly as bad." He still made paper hats at News-American.⁵² At the end of the day, Mr. Coppage reported wiping the units down.⁵³ Mr. Stallings reported that this wipe down would take 20 minutes after shift end; the new presses at the new pressroom still had blankets and plates and he reported that it may have taken an extra 5-10 minutes to clean these presses than the older models.⁵⁴

⁴² Deposition of James Coppage, March 11, 2019, Page 14-15.

⁴³ Deposition of James Coppage, March 11, 2019, Page 15.

⁴⁴ Deposition of James Coppage, March 11, 2019, Page 81.

⁴⁵ Deposition of James Coppage, March 11, 2019, Page 43.

⁴⁶ Deposition of Robert Stallings, April 14, 2009, Page 16.

⁴⁷ Deposition of James Coppage, March 11, 2019, Page 42-43.

⁴⁸ Deposition of James Coppage, March 11, 2019, Page 43-44.

⁴⁹ Deposition of Robert Stallings, April 14, 2009, Page 16-17.

⁵⁰ Deposition of James Coppage, March 11, 2019, Page 45.

⁵¹ Deposition of James Coppage, March 11, 2019, Page 45-46.

⁵² Deposition of James Coppage, March 11, 2019, Page 48.

⁵³ Deposition of James Coppage, March 11, 2019, Page 50.

⁵⁴ Deposition of Robert Stallings, April 14, 2009, Page 57.

According to Mr. Stallings' testimony, there were two different levels of journeymen at the News-American: one who worked on the upper level area of the press and one who worked on the lower level portions of the press—essentially, they would both be paired together on a press.⁵⁵ Apprentices would be rotated between working with an journeyman upstairs some weeks and with that downstairs other weeks.⁵⁶ With respect to cleaning activities, tasks were exactly the same for both the upstairs portion of the press and that of the downstairs portion of the press.⁵⁷ The apprentice would work side by side with the journeyman they were assigned to on a particular press during a given shift.⁵⁸ The apprentice did everything that the journeyman to whom he was assigned did and with respect to the cleaning of the presses, the journeyman and the apprentice equally cleaned at the same time—both would go to the 55-gallon drum and each would get a bucket and then clean the press.⁵⁹

As an apprentice, Mr. Coppage also assisted with the process of filling color ink at the presses; a junior pressman would bring the color ink to the press, and the apprentice or journeyman would put the ink into the ink fountain inside the press.⁶⁰ Mr. Stallings had a similar recollection of having refilled the color ink fountains.⁶¹ At the News-American, the color inks also came in 55-gallon drums with the black ink piped into the presses; he also recalled 10-gallon buckets of special color inks.⁶² This is consistent with Mr. Stallings' recollection of specialized color inks from Flint Inks, among others he couldn't recall, before offset technology was introduced in the industry.⁶³ The black ink at Alco was not piped in and came in 55-gallon drums with a hand crank for transferring the ink to the presses.⁶⁴

General Cleaning Tasks In and Around the Press

Mr. Stallings reported that generally at the end of a shift, a printing press would be cleaned by the apprentice/pressman that involved cleaning the blanket cylinder and the general work area in which the pressman would use a solvent to clean the blanket cylinders, the plate cylinders, and their general work area since these would get dirty with ink and lint from the paper.⁶⁵ In addition to cleaning the blanket cylinder and the plates, at the end of a shift, the general work area cleaning entailed the following: covers and hoods that go up and down on the units to cover the plate cylinder and blanket cylinder while the press is running, which would have to be cleaned off underneath and over the top.⁶⁶ They would first use the solvent to wipe down the dirty and inky

⁵⁵ Deposition of Robert Stallings, April 14, 2009, Page 77-78.

⁵⁶ Deposition of Robert Stallings, April 14, 2009, Page 79.

⁵⁷ Deposition of Robert Stallings, April 14, 2009, Page 79.

⁵⁸ Deposition of Robert Stallings, April 14, 2009, Page 79-80.

⁵⁹ Deposition of Robert Stallings, April 14, 2009, Page 80.

⁶⁰ Deposition of James Coppage, March 11, 2019, Page 47.

⁶¹ Deposition of Robert Stallings, April 14, 2009, Page 112-114.

⁶² Deposition of James Coppage, March 11, 2019, Page 48.

⁶³ Deposition of Robert Stallings, April 14, 2009, Page 112-114.

⁶⁴ Deposition of James Coppage, March 11, 2019, Page 185.

⁶⁵ Deposition of Robert Stallings, April 14, 2009, Page 18-19, 24-29.

⁶⁶ Deposition of Robert Stallings, April 14, 2009, Page 118-119.

roll cylinders and then get a new rag and more cleaner solution—three-quarters of a gallon to a gallon, to clean the general work area.⁶⁷ Regarding how many rags they would use on a daily clean-up, Mr. Stallings reported, 20-40 rags.⁶⁸

While cleaning at the end of the shift, an apprentice/pressman had the responsibility to clean two blanket cylinders and two plate cylinders as well as the ends of the inside of the units and also the outer perimeter of the units.⁶⁹ One blanket cylinder would take 5 minutes to clean.⁷⁰ Such cleaning took a minimum of 20 minutes, 90% of the time.⁷¹ A blanket cylinder was a little below the plate cylinder and approximately waist high.⁷²

Before cleaning the cylinders, Mr. Stallings would pour out the solvent from the 55-gallon drum into a smaller bucket, which probably held about 2 gallons according to his recollection, fill up the bucket half-way to about three-quarters (about a gallon or a little more), take to his work area, put on gloves, use the rags provided to dip into the solution, squeeze it out a little bit, and proceed wiping the cylinders.⁷³

As an apprentice Mr. Coppage reported having cleaned with solvents during times when the press went down and there were slow periods. He would also be part of maintenance crews for cleaning of the superstructure of the presses.⁷⁴ According to Mr. Stallings, cleaning of the superstructure, as part of maintenance crews occurred 4-6 times a year.⁷⁵ Some workers would be assigned to a maintenance crew to clean while others were assigned to their normal duties on getting the paper out that day.⁷⁶ Cleaning of the superstructure took about 2 days and they would go through 2 to 3 55-gallon drums during these 2 days.⁷⁷ Cleaning as part of the maintenance crew occurred during the slower January to Easter timeframe.⁷⁸ The manufacturer of the cleaning solutions were U.S. Printing Ink, Sun Chemical Company, and Hanco, except that they weren't delivered to the press like they were at News American since there was an ink room for them to get themselves.⁷⁹ Mr. Stallings reported that 60% of the time he would use the solvent from Sun Chemical Company and U.S. Printing Ink, with the remaining 40% Hanco.⁸⁰

⁶⁷ Deposition of Robert Stallings, April 14, 2009, Page 119-120.

⁶⁸ Deposition of Robert Stallings, April 14, 2009, Page 121.

⁶⁹ Deposition of Robert Stallings, April 14, 2009, Page 30.

⁷⁰ Deposition of Robert Stallings, April 14, 2009, Page 27.

⁷¹ Deposition of Robert Stallings, April 14, 2009, Page 30, 33.

⁷² Deposition of Robert Stallings, April 14, 2009, Page 28.

⁷³ Deposition of Robert Stallings, April 14, 2009, Page 28, 31.

⁷⁴ Deposition of James Coppage, March 11, 2019, Page 291.

⁷⁵ Deposition of Robert Stallings, April 14, 2009, Page 55-56.

⁷⁶ Deposition of Robert Stallings, April 14, 2009, Page 139.

⁷⁷ Deposition of Robert Stallings, April 14, 2009, Page 39.

⁷⁸ Deposition of Robert Stallings, April 14, 2009, Page 40.

⁷⁹ Deposition of Robert Stallings, April 14, 2009, Page 41.

⁸⁰ Deposition of Robert Stallings, April 14, 2009, Page 42-43.

Journeyman Pressman: Alco-Gravure a/k/a Quebecor, June 1969 – December 1998

According to Mr. Stallings, the only difference between an apprentice and a journeyman pressman was the increased pay and being permanently hired at one newspaper.⁸¹ A journeyman would typically be working on one press during an 8-hour shift; there were generally less apprentices, there wouldn't be a 1 to 1 ratio of journeymen to apprentices.⁸²

Mr. Coppage worked at Alco-Gravure starting in June 1969 as a regular journeyman pressman for 29 and one-half years until it closed in December of 1998.⁸³ He reported that the Alco was a gravure shop which was a different printing process.⁸⁴ Mr. Coppage reported that when he became a journeyman, he typically worked 35 hours a week.⁸⁵ As a journeyman pressman at the Alco, he reportedly worked 5-6 days a week; however, for about a 3-year period at the Alco, he worked 60-80 hours a week.⁸⁶

Job Tasks as a Journeyman Pressman at the Alco-Gravure

Mr. Coppage recalled an instance when he first started working at the Alco in which he felt intoxicated from the fumes and that he had to be taken outside to "sober up" and subsequently learned that "if you start feeling like that, then you just stop what you're doing and get away from the press. Get some fresh air for a little bit."⁸⁷

Mr. Coppage would reportedly work between the units on the presses at the Alco: he would use bamboo sticks to scrape off excess ink between the units on the cylinders; during this time, he would be standing between the units while the press was running at about 45,000 impressions an hour – there would be fumes while he did this since it was "right at the cylinder".⁸⁸

Mr. Coppage didn't generally wear gloves while working except during cleaning tasks.⁸⁹

Putting Solvent and Ink into the Presses and Cleaning up Spilled Ink at the Press

Mr. Coppage reported that the ink at Alco-Gravure would be mixed with Lactane which was the main solvent used at the press.⁹⁰ On the contrary, Mr. Stallings reported that Toluene was the solvent used on the presses at the Alco including for cleaning purposes;⁹¹ according to his recollection, 90% of the time, toluene was mixed with the printing ink as a quick-drying solution;

⁸¹ Deposition of Robert Stallings, April 14, 2009, Page 47, 50.

⁸² Deposition of Robert Stallings, April 14, 2009, Page 75-76.

⁸³ Deposition of James Coppage, March 11, 2019, Page 15.

⁸⁴ Deposition of James Coppage, March 11, 2019, Page 52.

⁸⁵ Deposition of James Coppage, March 11, 2019, Page 299.

⁸⁶ Deposition of James Coppage, March 11, 2019, Page 81.

⁸⁷ Deposition of James Coppage, March 11, 2019, Page 70.

⁸⁸ Deposition of James Coppage, March 11, 2019, Page 68-69.

⁸⁹ Deposition of James Coppage, March 11, 2019, Page 73-74.

⁹⁰ Deposition of James Coppage, March 11, 2019, Page 54.

⁹¹ Deposition of Robert Stallings, April 14, 2009, Page 45.

there would be a gauge on the pipes at the press where the pressman would mix the toluene with the ink which was done through the piping.⁹²

Mr. Coppage also recalled having used other solvents namely naphthol, xylene and xylol for different purposes: when the ink in the cylinder got too dry and lactane wasn't powerful enough, he would put xylol in to break up the dry part; if it was too wet, he would either add ink or "a couple gallons" of naphthol to help the drying process yet leave it wet enough to print.⁹³

Mr. Coppage would have the responsibility for putting ink in the presses at the Alco and described the process: there were 55-gallon drums of 4 inks—yellow, red, blue and black; there was a pump on the drums and he would put "10 turns of ink and 7 turns of lactane" which was the ink thinner; so he'd put in 10 gallons of ink and 7 gallons of lactane; after the ink fountains were filled on the press, he may have to adjust further by adding more ink or thinner.⁹⁴ The ink fountain held 80-90 gallons of ink and Mr. Coppage would top off the ink tank on the press every hour to hour and one-half with about 20 gallons of ink and the appropriate amount of lactane thinner.⁹⁵ The container holding the solvent/lactane to be added to the ink was called a bowser, a big square box on wheels with a lid; the paper handlers would bring ink and supplies to the press.⁹⁶ If he was in a hurry while loading the ink into the fountains and it backed up and spilled, he would be responsible for cleanup with lactane and a rag.⁹⁷

At some point, this system of manually refilling the color fountains on the presses changed in which all the colors and black ink was piped in – Mr. Coppage didn't recall when the system changed.⁹⁸ Once the inks were piped into the presses, there would still be ink and lactane spills if the monitor malfunctioned; he didn't report how often these spills happened.⁹⁹

Using Solvent to Clean Paper Breaks in the Press

Mr. Coppage reported that catalogue paper would break and subsequently wrap the rubber roller and cylinders that he would have to go inside the press and get it.¹⁰⁰ He described how he did so: he would turn the fountain off, open the door, and take a wet rag with lactane to wash off the paper on the cylinder and rubber roller since it was under pressure; during this whole time, he reported that he would be standing over the ink fountain.¹⁰¹ He reported that there would be

⁹² Deposition of Robert Stallings, April 14, 2009, Page 45, 108, 131.

⁹³ Deposition of James Coppage, March 11, 2019, Page 55.

⁹⁴ Deposition of James Coppage, March 11, 2019, Page 55-56.

⁹⁵ Deposition of James Coppage, March 11, 2019, Page 57.

⁹⁶ Deposition of James Coppage, March 11, 2019, Page 57.

⁹⁷ Deposition of James Coppage, March 11, 2019, Page 57-58, 66-67.

⁹⁸ Deposition of James Coppage, March 11, 2019, Page 63-64.

⁹⁹ Deposition of James Coppage, March 11, 2019, Page 66-67.

¹⁰⁰ Deposition of James Coppage, March 11, 2019, Page 58-59.

¹⁰¹ Deposition of James Coppage, March 11, 2019, Page 59.

fumes that came off of the ink and the lactane during this task.¹⁰² When he would clean the paper breaks, he reported getting the ink and lactane on his arms: some of the broken paper would get inside the ink fountain, so he would have to dig inside the fountain and he would then use the lactane to wash off the ink on his arms and later went into the locker room to use soap and water.¹⁰³ Regarding how often the paper broke, he reported “at least a couple times a day, or most days throughout his career at the Alco.”¹⁰⁴

Cleaning of the Superstructure of the Press with Solvent

During slow periods at the Alco, which was typically in January there would be cleaning of the whole presses – Mr. Coppage reported that maintenance crews would be formed, he himself would get on a crew and they would clean the presses.¹⁰⁵ Mr. Stallings estimated that a cleaning crew at the Alco consisted between 8-10 people since “they were huge presses.”¹⁰⁶ Cleaning of the presses involved cleaning the oven which involved taking pipes out which blew warm air to dry the paper – there would also be paper dust with ink on it that they’d have to clean out.¹⁰⁷

Mr. Stallings couldn’t approximate how much toluene was used during the cleaning since there was a pipe system in place in the ink room at the Alco where he would open up a valve to fill up a bucket; but he approximated 2-3 55-gallon drums.¹⁰⁸ During the 3-4 days that the maintenance crew would be cleaning the superstructure, Mr. Stallings estimated using 2-3 gallons personally to clean.¹⁰⁹

Miscellaneous Cleaning with Solvent

Mr. Coppage reported that if the Press was down, there would be extra men and they would have to go with solvent and rags and clean the press components—they would be wearing gloves during this task.¹¹⁰ Additionally, Mr. Coppage had responsibility to clean components associated with the Press ovens including the steam bars that dried the paper.¹¹¹ In addition, at the end of a shift, the journeyman would use solvent to clean the blankets and units where he worked.¹¹²

Journeyman Pressman: Baltimore Sun and Wall Street Journal, 1999 – 2000

After Alco-Gravure closed in 1998, the union set up a work pool in which whenever the Baltimore Sun or the Wall Street Journal needed pressman, Mr. Coppage would be called into

¹⁰² Deposition of James Coppage, March 11, 2019, Page 59-60.

¹⁰³ Deposition of James Coppage, March 11, 2019, Page 61.

¹⁰⁴ Deposition of James Coppage, March 11, 2019, Page 60.

¹⁰⁵ Deposition of James Coppage, March 11, 2019, Page 62-63.

¹⁰⁶ Deposition of Robert Stallings, April 14, 2009, Page 46.

¹⁰⁷ Deposition of James Coppage, March 11, 2019, Page 63-64.

¹⁰⁸ Deposition of Robert Stallings, April 14, 2009, Page 46.

¹⁰⁹ Deposition of Robert Stallings, April 14, 2009, Page 46.

¹¹⁰ Deposition of James Coppage, March 11, 2019, Page 62.

¹¹¹ Deposition of James Coppage, March 11, 2019, Page 61-62, 290-291.

¹¹² Deposition of Robert Stallings, April 14, 2009, Page 65.

work.¹¹³ He worked part-time at both papers as a Pressman during this timeframe.¹¹⁴ During this time period both papers were using offset presses, but Mr. Coppage didn't know the exact type of presses that were in use.¹¹⁵

Job Tasks as a Pressman at the Baltimore Sun and Wall Street Journal

General Work Around the Printing Press

Mr. Coppage's tasks as a Pressman at the Baltimore sun and Wall Street Journal included leading the papers through the different rollers, getting the press ready by putting the plates on the press and ensuring that the press was kept in register with the ink; in addition, if the paper broke, he would have to put it back in.¹¹⁶

Cleaning with Solvent

During this time in which he would work as an extra at the Baltimore Sun, he also would work in the ink room, cleaning buckets; he didn't have to do this at the Wall Street Journal and strictly worked on the press there.¹¹⁷ In addition to the ink buckets, he also cleaned parts of the press that were stained with ink for the maintenance crew since he would be an extra—he would use a solvent that came in 55-gallon drums to clean the ink buckets.¹¹⁸

Mr. Coppage reported that since the Wall Street Journal was a night publication, he would clean the presses during the day since they would get "messy" overnight; there were rollers and a super structure/frame on the presses.¹¹⁹

At the Baltimore sun, he reported having to clean the offset presses at the end of the run, particularly the cylinders with the solvent since it would build up with paper—he didn't know the name of the solvent.¹²⁰

As a Pressman, Mr. Coppage reported having cleaned with solvents during times when the press went down and there were slow periods; he would be part of maintenance crews during this cleaning work.¹²¹

¹¹³ Deposition of James Coppage, March 11, 2019, Page 16.

¹¹⁴ Deposition of James Coppage, March 11, 2019, Page 74, 115.

¹¹⁵ Deposition of James Coppage, March 11, 2019, Page 74-75.

¹¹⁶ Deposition of James Coppage, March 11, 2019, Page 75-76.

¹¹⁷ Deposition of James Coppage, March 11, 2019, Page 76.

¹¹⁸ Deposition of James Coppage, March 11, 2019, Page 77.

¹¹⁹ Deposition of James Coppage, March 11, 2019, Page 78.

¹²⁰ Deposition of James Coppage, March 11, 2019, Page 78-79.

¹²¹ Deposition of James Coppage, March 11, 2019, Page 291.

Journeyman Pressman: Baltimore Sun, 2000 – 2006

In 2000, Mr. Coppage was hired to work full time as a pressman at the Baltimore Sun and worked there until 2006 when he retired.¹²² He typically worked on the night shift, 5 days a week and sometimes 6 days, “but not too often.”¹²³ As a journeyman, he reported having the same duties as previous places he had worked as a journeyman pressman and reportedly worked on one press.¹²⁴ As a pressman, Mr. Coppage reported having cleaned with solvents during times when the press went down and there were slow periods; he would be part of maintenance crews during this cleaning work.¹²⁵

PRESSROOM CHARACTERIZATION AT THE NEWSPAPERS WHERE MR. COPPAGE WORKED

Baltimore Sun

According to Mr. Coppage’s recollection, the size of the original press room at the Baltimore Sun was that of a football field.¹²⁶ All of the printing presses were located in one large room— the presses were 3 stories high. Mr. Coppage reported that there was originally 4 presses with 9 units each when he started and that at some point, a fifth press was added which had 8 units.¹²⁷ There was a 3-5 feet exhaust on the ceiling but no fans, nor open windows.^{128,129} Somewhere around 1967/1968, the Sun started using color in its newspapers.¹³⁰

He reported the type of printing presses used during this time at the Sun were called Hoe presses, which was an old letterpress with lead plates—a kind of printing before offset.¹³¹ The letterpress had lead plates with the words and images raised on a cylinder.¹³² Black ink was piped into the press since it was used in much higher volumes but color inks were brought in 2-3 gallon buckets to manually refill the color fountains in the press.¹³³ Mr. Coppage recalled black ink from Flint, BASF, and Inmont over his 40-year career in the printing industry; however, he didn’t recall which papers used which ink.¹³⁴

¹²² Deposition of James Coppage, March 11, 2019, Page 16.

¹²³ Deposition of James Coppage, March 11, 2019, Page 82, 214.

¹²⁴ Deposition of James Coppage, March 11, 2019, Page 214.

¹²⁵ Deposition of James Coppage, March 11, 2019, Page 291.

¹²⁶ Deposition of James Coppage, March 11, 2019, Page 239.

¹²⁷ Deposition of James Coppage, March 11, 2019, Page 117-118.

¹²⁸ Deposition of James Coppage, March 11, 2019, Page 117-118, 72.

¹²⁹ Deposition of Robert Stallings, April 14, 2009, Page 138.

¹³⁰ Deposition of Robert Stallings, April 14, 2009, Page 147.

¹³¹ Deposition of James Coppage, March 11, 2019, Page 17-18.

¹³² Deposition of James Coppage, March 11, 2019, Page 17-18.

¹³³ Deposition of James Coppage, March 11, 2019, Page 20, 25.

¹³⁴ Deposition of James Coppage, March 11, 2019, Page 25-26, 40, 182-183.

The new pressroom at the Baltimore Sun, which Mr. Stallings recalled being built around the 1969 timeframe was bigger with a ceiling exhaust, no open windows, and higher ceiling.^{135,136} Mr. Coppage had recalled that the new pressroom at the Baltimore Sun was built in 1993. Nonetheless, the Sun went from letterpress operation to offset operation after the new pressroom was built.¹³⁷ The name of the new press was Goss Metro Offset.¹³⁸ There were 4, 12-unit presses at the new pressroom of the Sun.¹³⁹

Mr. Coppage reported that when he worked at the Baltimore sun, the 55-gallon drums of solvent were in the ink room.¹⁴⁰ This is consistent with the testimony of Mr. Stallings who recalled that the ink room where the drums of solvent were stored was a separate enclosed room at the end of the pressroom; he reported that at any given time, there would be 3 to 5, 55-gallon drums in the ink room.¹⁴¹ There would be drum valve that he would lift to fill a smaller bucket with solvent.¹⁴²

News-American

According to the testimony of Mr. Stallings, the News-American used the Goss Press; there were 8 Goss presses in the pressroom; a goss press was 8 units during this timeframe – there would be two blanket cylinders and two plate cylinders per unit and an average of 6-8 units would be run on a given Goss press.¹⁴³ Regarding how many journeymen and apprentices would be on a shift at the News-American during this timeframe, Mr. Stallings reported that it would vary depending on how many units were being ran for the day and that for 6 units there would be 10 journeymen and one apprentice, for 8 units, there could be 12 journeymen and one apprentice.¹⁴⁴ He estimated the room where the presses were located to be about the size of 15 basketball courts with the ceilings 4 stories high.¹⁴⁵

Mr. Stallings recalled the 3 manufacturers of the 55-gallon drums of solvent to be U.S. printing Inks, Sun Chemical Company and Hanco.¹⁴⁶ He reported regarding the Hanco solution that they were told it was a general-purpose cleaner instead of just specifically for blanket or roll cleaners.¹⁴⁷ When the drums were delivered to the press, they would be sitting upright on carriages and the pressman would unscrew the threads and put the petcock on and then cock the

¹³⁵ Deposition of James Coppage, March 11, 2019, Page 118-119.

¹³⁶ Deposition of Robert Stallings, April 14, 2009, Page 54-55.

¹³⁷ Deposition of Robert Stallings, April 14, 2009, Page 55.

¹³⁸ Deposition of Robert Stallings, April 14, 2009, Page 55.

¹³⁹ Deposition of Robert Stallings, April 14, 2009, Page 55.

¹⁴⁰ Deposition of James Coppage, March 11, 2019, Page 269.

¹⁴¹ Deposition of Robert Stallings, April 14, 2009, Page 83-84.

¹⁴² Deposition of Robert Stallings, April 14, 2009, Page 84.

¹⁴³ Deposition of Robert Stallings, April 14, 2009, Page 18, 26.

¹⁴⁴ Deposition of Robert Stallings, April 14, 2009, Page 27.

¹⁴⁵ Deposition of Robert Stallings, April 14, 2009, Page 32.

¹⁴⁶ Deposition of Robert Stallings, April 14, 2009, Page 19.

¹⁴⁷ Deposition of Robert Stallings, April 14, 2009, Page 63-64.

air valve.¹⁴⁸ He also recalled using Flint ink which were specialized color inks that came in 10 gallon buckets – before offset technology.¹⁴⁹ When Mr. Coppage worked at the News American, there was no separate ink room so inks and solvents were kept in the press room.¹⁵⁰ 269

Alco-Gravure

The printing process at the Alco was completely different than that of the Sun or News American; this was high quality commercial gravure printing – the presses were called Goss rotogravure presses.¹⁵¹ The technology didn't use plate cylinders nor blanket cylinders – there was a compression roller that was under 1000 PSI between the compression roller and lithograph cylinder.¹⁵²

According to Mr. Coppage, there were 4 presses at Alco-Gravure, one of which could be split into two presses to make 8 units a piece; in later years, two additional units were added for special runs; an additional pressroom was later added with 16 printing units and sometime after that a 5th press with 8 units was added.¹⁵³ He estimated that the presses were 3 stories at the very top of the ovens.¹⁵⁴ The ceiling was about 2 and a half stories high with an exhaust system in place; there was heating but no air conditioning.¹⁵⁵

The ink supply companies he recalled at the Alco included Inmont, and BASF.¹⁵⁶ He recalled that at some point in time, there was a recovery system in place to recover the “lactane” from the presses.¹⁵⁷ Even after the installation of the solvent recovery system at the presses, Mr. Coppage would still smell the solvent, coming off the press since, “the whole press was not sealed.”¹⁵⁸ He recalled that smell in the Alco-Gravure pressroom, “wasn't as much petroleum.”¹⁵⁹

Wallstreet Journal

No information was provided regarding the pressroom layout at the Wallstreet Journal.

¹⁴⁸ Deposition of Robert Stallings, April 14, 2009, Page 20.

¹⁴⁹ Deposition of Robert Stallings, April 14, 2009, Page 112-113.

¹⁵⁰ Deposition of James Coppage, March 11, 2019, Page 269.

¹⁵¹ Deposition of Robert Stallings, April 14, 2009, Page 43-44.

¹⁵² Deposition of Robert Stallings, April 14, 2009, Page 44.

¹⁵³ Deposition of James Coppage, March 11, 2019, Page 53, 119-120.

¹⁵⁴ Deposition of James Coppage, March 11, 2019, Page 71-72.

¹⁵⁵ Deposition of James Coppage, March 11, 2019, Page 120-121, 241.

¹⁵⁶ Deposition of James Coppage, March 11, 2019, Page 67.

¹⁵⁷ Deposition of James Coppage, March 11, 2019, Page 67.

¹⁵⁸ Deposition of James Coppage, March 11, 2019, Page 71.

¹⁵⁹ Deposition of James Coppage, March 11, 2019, Page 54.

SOLVENT USE IN PRESSROOMS

Mr. Coppage, was generally uncertain about the brand names of the solvents he used for cleaning the presses in the various newspapers he worked at throughout the years; He reported that the inks and the solvent used for cleaning both smelled like petroleum.¹⁶⁰

According to the testimony of Robert Stallings, the solvent inside the 55 gallon drums was referred to as “wash-oil”, a clear liquid with a sweet smelling odor.¹⁶¹ Mr. Stallings reported that if they used any of these substances inside the presses, and every time they used it they would get “a little dizzy over it.”¹⁶² The smell of the solvent was less intense during the workday as opposed to during cleaning; however, Mr. Stallings reported, “there was always a bucket or two around the press. In case someone needed to wipe up something, a spill or something, it would be readily available then.”¹⁶³ Mr. Stallings reported having observed more drums of solvent from U.S. Printing Ink and Sun Chemical than that of Hanco and attributed 75-80% to Sun Chemical and U.S. Printing Ink and 20-25% to Hanco.¹⁶⁴

WORK GEAR AND PERSONAL PROTECTIVE EQUIPMENT USE IN PRESSROOMS

Baltimore Sun provided uniforms both long and short pants and shirts.¹⁶⁵ Both the News-American and the Alco did not provide uniforms, and Mr. Stallings reported having to wear work shirt and pants, short sleeves and shorts during the summer and long pants and long sleeves during the winter.¹⁶⁶

According to the testimony of Mr. Stallings, apprentices or journeymen were never provided with a respirator at any of the newspapers.¹⁶⁷ The general hat workers wore was a newspaper that they folded up into a hat.¹⁶⁸ Mr. Stallings recalled using “rubberized gloves” provided by the papers to handle the solvents.¹⁶⁹ In addition, Mr. Stallings reported that they took a shower at the premises before they left each day at the Sun, News American, and the Alco.¹⁷⁰

¹⁶⁰ Deposition of James Coppage, March 11, 2019, Page 31, 106-109.

¹⁶¹ Deposition of Robert Stallings, April 14, 2009, Page 21.

¹⁶² Deposition of Robert Stallings, April 14, 2009, Page 22.

¹⁶³ Deposition of Robert Stallings, April 14, 2009, Page 91.

¹⁶⁴ Deposition of Robert Stallings, April 14, 2009, Page 42.

¹⁶⁵ Deposition of Robert Stallings, April 14, 2009, Page 90.

¹⁶⁶ Deposition of Robert Stallings, April 14, 2009, Page 89-90.

¹⁶⁷ Deposition of Robert Stallings, April 14, 2009, Page 66.

¹⁶⁸ Deposition of Robert Stallings, April 14, 2009, Page 97.

¹⁶⁹ Deposition of Robert Stallings, April 14, 2009, Page 22.

¹⁷⁰ Deposition of Robert Stallings, April 14, 2009, Page 90.

EXPOSURE ASSESSMENT

Mr. Coppage's work activities can be divided into three main categories: production printing; daily cleaning; and maintenance cleaning. Production tasks include Plate Change, Paper Load and Unload, Color Inspection, Repair, Maintenance, Inventory, and Miscellaneous activities.¹⁷¹

Table 2 Summary of James Coppage Benzene Exposures in the Printing Industry

Employer	Job Title	Duration	Process	Benzene Exposed Tasks			
				Production*	Daily Cleaning Press	Daily Cleaning Ink Buckets	Maintenance Cleaning
Baltimore Sun	Junior Pressman	1960 – 1965	Hoe letterpress	1 ppm	Yes	Yes	Yes
Boone Press Inc.	Junior Pressman	1961 – 1966	–	NR	NR	NR	NR
Twentieth Century Printing Company	Junior Pressman	1963	–	NR	NR	NR	NR
Baltimore Sun	Apprentice	1965 – 1969	Hoe letterpress	1 ppm	Yes	Yes	Yes
News-American	Apprentice	1965 – 1969	Goss letterpress	1 ppm	Yes	No	Yes
Alco-Gravure	Apprentice	1965 – 1969	Rotogravure	2.3 ppm	Yes**	No	Yes
Alco-Gravure	Journeyman Pressman	1969 – 1998	Rotogravure	2.3 ppm 1969-70; 0.15 ppm 1971 to 1998	Yes**	No	Yes
Baltimore Sun	Journeyman Pressman	1999 – 2000	Goss offset press	0.8 ppm	Yes	Yes	No
Wallstreet Journal	Journeyman Pressman	1999 – 2000	Offset press	0.8 ppm	Yes	No	No
Baltimore Sun	Journeyman Pressman	2000 – 2006	Goss offset press	0.8 ppm	Yes	No	Yes
NR not reported ppm parts per million * Exposure levels cited in published literature and reports summarized below. ** Daily press cleaning at Alco-Gravure was conducted at least a couple times per day as part of clearing paper breaks							

Production Printing

Mr. Coppage's exposures during the periods when presses were running routinely can be described by citing a set of publications and reports, summarized chronologically in the following paragraphs.

¹⁷¹ Hansen DJ and Whitehead LW. 1988. The Influence of Task and Location on Solvent Exposures in a Printing Plant. *American Industrial Hygiene Association Journal*, 49(5):259-265.

1978

A report by Renson (1978) submitted to the OSHA benzene docket commented on the benzene levels in air measured at 32 ink manufacturing plants in early to mid-1977.¹⁷² Benzene levels in air measured at 0.15 parts per million (ppm) (8-hour time-weighted averages) were reported. Solvents typically used in inks and benzene content (range) as of 1978 were also summarized by Renson (shown below).

Table 3 Summary of Benzene Content in Solvents Contained in Printing Ink (Source: Renson, 1978)

Solvent	Percent Benzene by Volume
Heptane	0.1 % – 0.75%
Heptane – Aromatic-free	0.01% – 0.02%
Toluene	0.02% – 0.1 %
Lactol Spirits	0.02% – 0.1 %
Xylene	0.15%
Aliphatic hydrocarbon blend	0.01% – 0.02%

1988

Hansen and Whitehead (1988) described the times to perform specific tasks by operators of offset presses in the mid to late 1980s along with total solvent exposure levels.¹⁷³ There was a strong relationship between solvent exposures and the number of plate changes during a shift. The authors noted that the operators usually wiped the plates and drums with solvents during the plate changes. Workers tended to stay located near the presses during the workday. Typical tasks and task durations reported are summarized as follows:

Table 4 Typical Worker Tasks and Task Duration (Source: Hansen and Whitehead, 1988)

Worker Tasks	Task Minimum Time (minutes)
Plate Change	6 to 7
Load Paper	10 to 20
Unload Paper	10 to 20
Color Inspection	10
Repair	15 to 60
Maintenance	10 to 30
Inventory	15
Miscellaneous	10

1990

Kaiser and McManus (1990) monitored employee exposure to hydroquinone, 2-butoxy ethanol, isopropyl alcohol, N-propyl alcohol, naphtha, and benzene using personal air samplers in late

¹⁷² Renson JE. 1978. *May 11, 1978 Statement of James E. Renson, Executive Director*, representing The National Association of Printing Ink Manufacturers (NAPIM), OSHA Docket H059A, Item 46-96.

¹⁷³ Hansen DJ and Whitehead LW. 1988. The Influence of Task and Location on Solvent Exposures in a Printing Plant. *American Industrial Hygiene Association Journal*, 49(5):259-265.

1988 at a print shop in Rhode Island.¹⁷⁴ This was a commercial printer utilizing offset and letterpress processes and had been in operation at this location since 1974. Personal breathing zone samples were collected for two sheet-fed press operators who were monitored for full-shift benzene and naphtha solvent exposures. Blanket Wash #106 containing benzene and naphtha was used to clean press rollers. Operators performed 6 to 8 blanket and roller washes per shift using this solvent mixture. This procedure takes about two to five minutes. Typically, a rag was dipped into a solvent bucket, or the solvent was applied to the rag from an application bottle, then the roller surfaces were wiped several times. Sometimes solvent was applied to the surfaces using a squirt bottle while the rollers are spinning; then they were wiped down. Personal exposures to benzene ranged from 0.98 to 1.10 ppm as full shift (7 to 8 hour) time-weighted averages.

1991

Nise et al. (1991) reported on historic exposures of rotogravure printers in Sweden, including inhalation exposure data to toluene, and historic levels of benzene in toluene. Benzene levels in air can be estimated from this combined data. Results are summarized below.¹⁷⁵

Table 5 Summary of Historic Toluene Exposures, Rotogravure Printers in Sweden (Source: Nise et al., 1991)		
Time/Era	Mean Toluene Exposure (mg/m³)	Mean Toluene Exposure (ppm)
1950s	1,500	397.5
1960s	1,500	397.5
1970s	800	212
1986	150 (range: 30 to 420)	39.75 (range: 7.97 to 111.3)
mg/m ³ milligram per cubic meter ppm parts per million		

While air benzene levels were not measured at this plant, levels of benzene in liquid toluene were reported as follows. Calculated air benzene levels based upon the air toluene levels and benzene content in toluene over time are:

¹⁷⁴ Kaiser EA and McManus KP. 1990. *NIOSH Health Hazard Evaluation Report (HETA) #88-346-2030, Graphic Creations, Inc., Warren, Rhode Island*. National Institute for Occupational Safety and Health.

¹⁷⁵ Nise G, Hogstedt B, Bratt I and Skerfving S. 1991. Cytogenetic Effects in Rotogravure Printers Exposed to Toluene (and Benzene). *Mutation Research*, 26(3):217-223.

Table 6 Summary of Historic Calculated Benzene Levels in Liquid Toluene (Source: Nise et al., 1991)			
Time/Era	Benzene in Toluene (%)	Calculated Benzene in Air (mg/m ³)	Calculated Benzene in Air (ppm)
1950s	10	150	47
1960s	0.5	7.5	2.3
1970s	0.05	0.4	0.13
1986	0.01	0.015	0.005
mg/m ³ milligram per cubic meter ppm parts per million			

1995

Wadden et al. (1995) presented information on ventilation rates and toluene emission rates from a large production rotogravure printing operation in 1994. It includes composition information on commercial solvent products used in printing operations at that time. No benzene-in-air data were provided; however, the authors reported the weight percentage of benzene in the total volatile organic compound (VOC) levels was 0.22 in room air while the value for toluene was 91.22. So the benzene to toluene ratio by weight fraction in air was 0.0024. The average toluene in air level over 12 areas of the plant was 193 milligrams per cubic meter (mg/m³), so the estimated benzene level would be (193) (0.0024) = 0.46 mg/m³ benzene (0.15 ppm).¹⁷⁶

1995

IARC (1995) reviewed and summarized worker exposures in monograph #65 Printing Processes and Printing Inks, Carbon Black and Some Nitro Compounds.¹⁷⁷ Industrial hygiene surveys conducted in the United States by the Occupational Safety and Health Administration between 1979 and 1994 reported the 12 most commonly monitored exposures in the printing industry were noise, toluene, isopropanol, xylenes, petroleum distillates, acetone, Stoddard solvent, methyl ethyl ketone, methylene chloride, carbon monoxide, lead and benzene. Exposure to inks and resins occurred by splashing and misting from press rollers, with the highest solvent exposures during clean-up (25% of the work time), when rollers were wiped with press wash solutions. This latter operation provided the opportunity for dermal exposure as well as inhalation.

Benzene concentrations in one Swedish rotogravure plant in 1960 to 1962 ranged from 0 to 61 ppm (0 to 195 mg/m³) and averaged 3 ppm (9.6 mg/m³). Toluene concentrations ranged from 300 to 450 ppm (1,130 to 1,695 mg/m³) between 1920 and 1965 in six rotogravure factories, but dropped to average concentrations of less than 50 ppm (190 mg/m³) by 1985. The Swedish study of the rotogravure industry by Nise et al. (1991) (discussed previously) reported median toluene

¹⁷⁶ Wadden RA, Suero M, Conroy LM, Franke JE, and Scheff PA. 2001. Characterization of Publication Rotogravure Press Emission Rates and Compositions. *Applied Occupational and Environmental Hygiene*, 16(4):471-481.

¹⁷⁷ IARC. 1995. *Printing Processes and Printing Inks, Carbon Black and Some Nitro Compounds, Volume 65*. In: IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, October 10-17. Lyon, France: International Agency for Research on Cancer.

concentrations of 33 ppm (124 mg/m³) in two plants and 7 ppm (26 mg/m³) in a third, more modern plant from 1983 to 1986. Calculated benzene levels ranged from 47 ppm in the 1950s to 0.47 ppm in the 1980s.

1996

Wilbourn et al. (1996) stated that in lithographic and letterpress printing, the major exposure is to hydrocarbon-based cleaning solvents and isopropanol from fountain solutions.¹⁷⁸ Historically, some workers in both ink manufacturing and printing were exposed to much higher levels of lead, polycyclic aromatic hydrocarbons (PAHs), and benzene than in 1996.

1997

Crouch et al. (1997) noted that press operators and other workers in printing establishments are exposed to airborne solvent vapor generated when the press is cleaned and that some of these press-cleaning solvents contain methylene chloride, benzene, and perchloroethylene.¹⁷⁹ Many cleaning solvents are absorbed through the skin providing another route for exposure. The paper notes that benzene is contained in press cleaning solvents and commented on the need for engineering controls and personal protective equipment needed to protect workers.

1999

Cook and Page (1999) monitored employee exposure to naphthas, 2-butoxyethanol, and rosin by measuring aldehydes and resin acids (specifically abietic and dehydroabietic acids) using personal air samplers in the breathing zones of workers and area samples in September 1999 at a facility located in Illinois.¹⁸⁰ The authors commented on typical operations, exposures, and health effects. During printing operations, workers used blanket wash solutions and wetting agents (also called fountain solutions) as solvent cleaners. Press equipment was cleaned or wiped down 2 to 3 times per shift with a more thorough cleaning done a few times each week. The cleaning was done manually with solvent-wetted shop rags. Cleaning sessions lasted about one hour; some cleaning tasks required three workers working several hours. The blanket wash contained petroleum naphtha.

Most of the workers with reported rashes on their skin were pressroom workers that had dermal contact with solvents. The authors reported that the rashes were not associated with airborne exposures, but that the primary mode of exposure was direct dermal contact. While not directly

¹⁷⁸ Wilbourn J, Partensky C, and Morgan WG. 1996. IARC Evaluates Printing Processes and Printing Inks, Carbon Black and Some Nitro Compounds, *Scandinavian Journal of Work Environment & Health*, 22:154-156.

¹⁷⁹ Crouch KG, Hagedorn RT, Carlson R, and Flesch JP. 1997. *Controlling Cleaning-Solvent Vapors at Small Printers*. National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 98-107.

¹⁸⁰ Cook CK and Page EH. 1999. *NIOSH Health Hazard Evaluation Report (HETA) #99-0137-2810, World Color Press Effingham, Illinois*. National Institute for Occupational Safety and Health.

stating the workers did not wear gloves during cleaning operations, they noted and recommended that workers wear appropriate gloves to limit dermal exposures.

Measured naphtha exposures in a reportedly well-ventilated facility are summarized below.

Table 7 Naphtha Exposure Results		
Job Category/Area	Sample Times (min.)	Naphtha in Air (mg/m³)
September 8, 1999		
Press #219 Operator – PBZ	437	37
Press #228 Operator – PBZ	391	41
Press #228 Operator – PBZ	323	37
Press #228 Operator – PBZ	413	27
Press #228 Operator – PBZ	411	27
Press #231 Operator – PBZ	393	17
Press #231 Operator – PBZ	393	48
Press #231 Operator – PBZ	294	24
Press #231 Operator – PBZ	295	32
Press #231 Operator – PBZ	295	98
Press #231 Operator – PBZ	296	44
Press #219 – Area	414	23
Press #228 – Area	404	42
Outdoor - Area	440	<0.11
September 9, 1999		
Press #219 Operator – PBZ	436	18
Press #219 Operator – PBZ	373	26
Press #226 Operator – PBZ	453	24
Press #231 Operator – PBZ	296	31
Press #227 – Area	424	40
min minutes mg/m ³ milligram per cubic meter		

Analytical results from this work suggest that worker samples and area samples for the same press were quite similar. Average worker exposures to naphtha over the two-day period were 35.4 mg/m³ (range of values from 17 to 98 mg/m³) while the average area sample was 35.0 mg/m³ (range of values from 23 to 42 mg/m³).

2003

Schaper et al. (2003) reported the results of a study on the toxicity of occupational exposure (TWAs) to toluene at rotogravure printing plants (5 facilities for historic data and 14 facilities for current data) in Germany.¹⁸¹ The mean toluene exposure for the printing area before 1975 was 135 ppm. The mean exposure in 1995 was 40 ppm. The mean exposure for the recent samples (2002) was 25.7 ppm. This data illustrates the reduced exposure to printers with time.

¹⁸¹ Schaper M, Demes P, Zupanic M, Blaszkewicz M and Seeber A. 2003. Occupational Toluene Exposure and Auditory Function: Results from a Follow-up Study. *Annals of Occupational Hygiene*, 4(6):493-52.

2003

Wijngaarden et al. (2003) conducted an extensive review of the literature to determine benzene exposures by occupation.¹⁸² Regarding printers, they noted: “In addition, until the early 1960’s benzene was a major component used for printing and lithography, adhesives and coatings.” As late as the 1980s, benzene was reported to be present in 0.4% of the thinners, degreasers, paints, inks, and some reagents in Germany; similar results were found in Japan. Benzene in air exposure data, by SIC code, was presented:

Table 8 Benzene in Air Exposure Data (Source: Wijngaarden et al., 2003)			
Benzene in Air (ppm) SIC	Description of Industry	Number of Samples	Mean Exposure Level (ppm)
2752-2759	Commercial Printing	12	0.58
ppm parts per million SIC Standard Industrial Classification			

2006

Rodriguez and Gibbins (2006) monitored exposures to 1,2,4 trimethylbenzene, 1,3,5 trimethylbenzene, benzene, ethylbenzene, toluene, xylene, and petroleum distillates using area air samplers in 2006 at a printing facility located Michigan.¹⁸³

Exposure data reported from near the offset presses is summarized below.

Table 9 Exposure Results Near Offset Presses (Source: Rodriguez and Gibbins, 2006)					
Location/Area	Sample Time (min)	1,2,4 TMB	1,3,5 TMB	Toluene	Xylene
		Concentration (mg/m³)			
Top of Printing Press Control Panel	430	5.9	2.7	2.15	1.6
Back End of Printing Press	433	6.9	3.0	2.3	1.8
40" Offset Press	429	5.5	2.6	2.6	1.8
29" Offset Press	422	6.1	2.2	2.3	1.7
min minutes TMB trimethylbenzene mg/m ³ milligram per cubic meter					

Average toluene exposure was 2.3 mg/m³; if the toluene contained 0.05% benzene, then the average benzene exposure is calculated to be 0.001 mg/m³ benzene (0.0003 ppm).

¹⁸² Wijngaarden EV and Stewart PA. 2003. Critical Literature Review of Determinants and Levels of Occupational Benzene Exposure for United States Community-Based Case-Control Studies. *Applied Occupational and Environmental Hygiene*, 18:678-693.

¹⁸³ Rodriguez M and Gibbins J. 2007. *NIOSH Health Hazard Evaluation Report (HETA) #2006-0343-3045, Nuisance Odors from a Neighboring Printing Facility – Air Quality Evaluation at a Label Distributing Company, Schreiner Label Tech, Southfield, Michigan*. National Institute for Occupational Safety and Health.

Summary of Exposures During Production Printing

Exposures to benzene in offset press production printing prior to 1977 were substantially higher than in later years due to the use of products, particularly solvents containing at least 50% benzene.¹⁸⁴ Therefore, the estimated benzene exposures during cleaning the offset presses at the Baltimore Sun and News-American were modeled separately for Mr. Coppage's employment starting in 1960 through 1977 from his exposures in 1978 and later in his employment.

In their critical review of Determinants and Levels of Occupational Benzene Exposure, Wijngaarden and Stewart 2003 determined an 8-hour time-weighted average of 0.58 ppm benzene to be the mean exposure for commercial printing in the US and Canada.¹⁸⁵ This value was based upon the available quantitative exposure data (12 samples). The coefficient of variation (mean divided by the sample standard deviation) was 138. The authors rated their level of confidence in this value to be moderately high.

This value is consistent with the data from Kaiser and McManus (sampling in 1988) who reported personal breathing zone exposures to benzene in offset printing ranging from 0.98 to 1.10 ppm.¹⁸⁶ The personal samples were collected during work processes that included cleaning rollers with Blanket Wash #106. This product contained benzene (quantity not reported) and the cleaning was reportedly conducted 6 to 8 times per day (8-hour shift) for between 2 to 5 minutes per event.

Specifically, in rotogravure printing, the measurement of toluene concentrations in air, and the benzene concentrations of liquid toluene over time reported by Nise et al. (1991) allow the calculation of estimated benzene in air levels.¹⁸⁷ These estimates range from 47 ppm in the 1950s, 2.3 ppm in the 1960s, 0.13 ppm in the 1970s, and 0.005 ppm in the mid-1980s.

Exposures During Cleaning 1960 – 1977 (Baltimore Sun and News-American)

As for cleaning specifically, Mr. Coppage (and Mr. Stallings) described daily cleaning steps for the ink buckets (2 hours per day), and press components including rollers, frame, and ink rails. As a junior pressman, Mr. Coppage was responsible for cleaning ink buckets for a period of 2 hours per day. He did not specify the number of days per week he conducted this task so I conservatively estimated that he did this twice (2 days) each week during the 5 years (1960-1965) he worked as a junior pressman at the Baltimore Sun.

¹⁸⁴ Deposition of Charles Graham, July 15, 2010, Page 254.

¹⁸⁵ Wijngaarden EV and Stewart PA. 2003. Critical Literature Review of Determinants and Levels of Occupational Benzene Exposure for United States Community-Based Case-Control Studies. *Applied Occupational and Environmental Hygiene*, 18:678-693.

¹⁸⁶ Kaiser EA and McManus KP. 1990. *NIOSH Health Hazard Evaluation Report (HETA) #88-346-2030, Graphic Creations, Inc., Warren, Rhode Island*. National Institute for Occupational Safety and Health.

¹⁸⁷ Nise G, Hogstedt B, Bratt I. and Skerfving S. 1991. Cytogenetic Effects in Rotogravure Printers Exposed to Toluene (and Benzene). *Mutation Research*, 26:217-223.

As he cleaned the ink buckets by working over the open surface of the 4 by 4 feet square metal tank containing solvent, his inhalation exposure can be estimated using the two-zone (near field and far field) model with constant emission. Exposures during the various cleaning procedures were calculated using a modeling approach derived from the AIHA.¹⁸⁸ The same modeling approach was employed by Nicas and Neuhaus (2008) to estimate task-based benzene exposures and compare the estimates with measured exposure levels.¹⁸⁹

The predicted exposures resulting from the vaporization of the benzene during various cleaning activities in the pressroom were calculated using the Near Field/Far Field (2 Box) model approach. This modeling approach estimates contaminant concentrations resulting from evaporation of liquid from a wetted surface. This model has two general forms, one for estimating concentrations in the near field, which in this case was the distance from the part being cleaned to Mr. Coppage's breathing zone, approximately 2.5 feet (0.75 meters). The second form is for the far field, which is distances greater than 0.75 meters from Mr. Coppage.

The near field model is presented below:

$$C_{NF}(t) = \frac{G}{Q} + \frac{G}{\beta} + G \left(\frac{\beta \cdot Q + \lambda_2 \cdot V_{NF}(\beta + Q)}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_1 \cdot t) - G \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + Q)}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_2 \cdot t)$$

here C is the near field concentration mg/m³

G is the emission rate in mg/min

Q is the ventilation rate

B is the exchange rate between zones = 1/2 (FSA) (S) where FSA is the free surface area of the near field geometry (in this case 7.07 m²) and S is the random air velocity at the near field-far field interface (in this case median air speed of 3.57 m min⁻¹ [11.7 ft min⁻¹]) reported in a survey of air speeds in indoor workplaces.¹⁹⁰

The values for the input parameters to the model are derived from information provided by Mr. Coppage about the rate at which he used benzene-containing solvents in the various places he worked, as well as the record in the case including the composition of the products during the time at which he was employed. Specifically, on the benzene content of the solvents Mr. Coppage used in the various cleaning processes, the benzene content until at least 1977 was 50 percent based upon information provided by Charles Graham.¹⁹¹

¹⁸⁸ AIHA. 2014. Mathematical Models for Estimating Occupational Exposures to Chemicals, Second Edition. Falls Church, VA: American Industrial Hygiene Association

¹⁸⁹ Nicas M and Neuhaus J. 2008. Predicting Benzene Vapor Concentrations with a Near Field/Far Field Model. *Journal of Occupational and Environmental Hygiene*, 5(9):599-608.

¹⁹⁰ Baldwin P and Maynard A. 1998. A survey of wind speeds in indoor workplaces. *Annals of Occupational Hygiene*, 42(5):303-313.

¹⁹¹ Deposition of Charles Graham, July 15, 2010, Page 254.

In the case of the benzene emissions from cleaning the ink buckets, and the press surfaces, the generation rate G was estimated by the approach of Nicas and Neuhaus (2008), cited previously in their predictions of benzene levels in air.

Here the benzene emission rate $G(t)$ in units (mg min^{-1}) is:

$$G(t) = \alpha \times M \times \exp(-\alpha \times t)$$

where M is the mass (mg) of benzene applied at the start of the cleaning period. The value assigned to α is 0.139 min^{-1} , which corresponds to an evaporation half time of 5 min for benzene. Mr. Stallings' description of the cleaning process indicates that he dipped a rag into the solvent and wiped the surface to be cleaned, then stopped using one rag and put it in the (used rag) container when they got dirty and he would have to switch to another rag. And when he switched to another rag, he got the solution on the new rag by dipping it into the bucket again. In these cleaning/wiping processes I estimate that the rags were replaced every five minutes, so a clean rag was dipped in fresh solvent and used for wiping every five minutes. For this calculation I assumed that the quantity of solvent contained on each rag was 100 milliliters (approximately 3 ounces), and the benzene concentration in the solvent was 50% during the time when Mr. Coppage cleaned ink buckets and press surfaces at the Baltimore Sun (1960-1969).

For cleaning the ink buckets, Mr. Coppage reported that he used a bucket to transport 5 or 6 gallons of solvent to the square tank to clean the ink buckets.

So, to calculate M the mass of benzene applied in each 5-minute cycle,

$M = (\text{volume solution applied}) (\text{volume fraction benzene}) (\text{density benzene})$

$M = (100) (0.5) (880) = 44\,000 \text{ mg benzene evaporated during each 5-minute cleaning cycle in the ink bucket and press surface cleaning,}$

then G over the 5-minute period is $(0.139) (44\,000) (e^{-0.139 \times 5}) = 3052 \text{ mg/min}$

The room volume was estimated by Mr. Coppage to be about the size of 15 basketball courts, this is calculated to be $79,832 \text{ m}^3$. If the room air change rate was 5 air changes per hour, Q (the airflow into the room) would be $6,653 \text{ m}^3/\text{min}$.

For the average exposure over the 120-minute period of ink bucket cleaning, the model results for Mr. Coppage's inhalation exposure (the near field result) is $332 \text{ mg/m}^3 = 104 \text{ ppm}$ benzene (model results attached in Appendix A). So, on days when he did ink bucket cleaning for a 2-hour period, Mr. Coppage's daily average benzene exposure (assuming 1 hour total unexposed for breaks and lunch) was

$$\frac{(104 \text{ ppm} \times 2 \text{ hours}) + (1 \text{ ppm} \times 5 \text{ hours}) + (0 \text{ ppm} \times 1 \text{ hour})}{8 \text{ hours}}$$

= 26.6 ppm as his daily time-weighted average benzene exposure.

For the average exposure over the 20 minute (0.33 hours) period of daily press cleaning, the model results for Mr. Coppage's inhalation exposure (the near field result) is $332 \text{ mg/m}^3 = 104 \text{ ppm}$ benzene. His daily benzene exposure therefore was

$$\frac{(104 \text{ ppm} \times 0.33 \text{ hours}) + (1 \text{ ppm} \times 6.67 \text{ hours}) + (0 \text{ ppm} \times 1 \text{ hour})}{8 \text{ hours}}$$

= 5.1 ppm as his daily time-weighted average benzene exposure

In the cases of the maintenance cleaning which was done approximately twice a year for 2 to 3 day periods at the Baltimore Sun according to Mr. Coppage, his daily average benzene exposure was 104 ppm benzene for the 6 to 7 hours he was exposed each day. So on those days if he was exposed for 6 of the 8 hours in the workday, his daily time-weighted average exposure on those days was 78 ppm. As he reportedly conducted the maintenance cleaning for five out of the 240 working days in a year, his time exposed to benzene from maintenance cleaning would on average be 0.1 days per week.

Exposures During Cleaning – Alco-Gravure

Daily press cleaning at Alco-Gravure was conducted at least a couple times per day as part of clearing paper breaks, rather than at the end of each shift as done at the other printing presses. The more extensive maintenance cleaning on the presses and superstructure was conducted once a year in January after catalogues were printed.

The exposures associated with the daily and yearly cleanings were estimated using the same modeling approach described previously for Mr. Coppage's benzene exposures at the Baltimore Sun and News – American. The solvents used at Alco-Gravure, however, were reportedly different. Mr. Coppage reported that the ink at Alco-Gravure would be mixed with Lactane, which was the main solvent used at the press. Lactane is a low-boiling light petroleum distillate. On the contrary, Mr. Stallings reported that Toluene was the solvent used on the presses at the Alco including for cleaning purposes.

For these calculations in modeling Mr. Coppage's benzene exposures from the use of Lactane or Toluene as a cleaning solvent, I conservatively estimated the benzene content of these materials at 0.05%. This results in a calculated benzene vapor generation rate G of 3 mg/min using the same calculation method as for the solvent used at the Baltimore Sun and News American. The model results for Mr. Coppage's inhalation exposure (the near field result) is $0.336 \text{ mg/m}^3 = 0.105 \text{ ppm}$ benzene as his average exposure for a 20-minute cleaning period. For the day-long cleaning

period the average for the 7-hour period was $0.338 \text{ mg/m}^3 = 0.105 \text{ ppm}$ (model results attached in Appendix A).

Exposures During Cleaning 1999-2006 (Baltimore Sun and Wall Street Journal)

By the time Mr. Coppage returned to the Baltimore Sun and Wall Street Journal as a journeyman pressman in 1999, the benzene content in materials used in offset printing had been very substantially reduced. Product substitution of benzene with toluene and other materials in the time window 1977 through 1985 had resulted in lower benzene exposure levels in the pressrooms.¹⁹² For these calculations in modeling Mr. Coppage's benzene exposures from the use of toluene-containing materials as cleaning solvents, I conservatively estimated the benzene content of these materials at 0.05%. This results in a calculated benzene vapor generation rate G of 3 mg/min using the same calculation method as for the higher benzene content solvent used earlier at the Baltimore Sun. The model results for Mr. Coppage's inhalation exposure (the near field result) is $0.336 \text{ mg/m}^3 = 0.105 \text{ ppm}$ benzene as his average exposure for a 20-minute cleaning period. For the average exposure over the 120-minute period of ink bucket cleaning, the model results for Mr. Coppage's inhalation exposure (the near field result) is $0.336 \text{ mg/m}^3 = 0.105 \text{ ppm}$ benzene (model results attached in Appendix A). For the day-long cleaning period the average for the 7-hour period was $0.338 \text{ mg/m}^3 = 0.105 \text{ ppm}$ (model results attached in Appendix A). For Mr. Coppage's work at the Baltimore Sun including production printing, exposures are estimated for a 20-minute period of daily press cleaning, cleaning of ink buckets conservatively estimated at twice a week for 2 hours each time, and general maintenance cleaning for a 2-day period twice a year.

So, on days when he did ink bucket cleaning for a 2-hour period, Mr. Coppage's daily average benzene exposure (assuming 1 hour total unexposed for breaks and lunch) was

$$\frac{(0.105 \text{ ppm} \times 2 \text{ hours}) + (0.8 \text{ ppm} \times 5 \text{ hours}) + (0 \text{ ppm} \times 1 \text{ hour})}{8 \text{ hours}} = 0.53 \text{ ppm as his daily time-weighted average benzene exposure.}$$

On days when he did the cleaning of the presses but not the ink buckets, his daily time-weighted average benzene exposure was

$$\frac{(0.105 \text{ ppm} \times 0.33 \text{ hours}) + (0.8 \text{ ppm} \times 6.67 \text{ hours}) + (0 \text{ ppm} \times 1 \text{ hour})}{8 \text{ hours}} = 0.67 \text{ ppm}$$

¹⁹² Deposition of Charles Graham, July 15, 2010, Page 268.

Exposures by Work Location*Baltimore Sun Junior Pressman 1960 – 1965 (duration 5 years)*

Mr. Coppage conducted production printing which included a 20-minute period of daily cleaning, cleaning of ink buckets conservatively estimated at twice a week for 2 hours each time, and general maintenance cleaning for a 2-day period twice a year. His daily average benzene exposure is calculated as:

$$\frac{5.1 \text{ ppm (3 days)} + 26.6 \text{ ppm (2 days)} + 78 \text{ ppm (0.1 days)}}{5 \text{ days}}$$

$$= 15.3 \text{ ppm}$$

There is insufficient information in the record to estimate Mr. Coppage's exposures during his brief employments at Boone Press Inc. and Century Printing Company.

Baltimore Sun Apprentice 1965 – 1969

Based upon his description of his rotation as an apprentice, Mr. Coppage worked at the Baltimore Sun for a total of 22 months (1.8 years) during this period. Mr. Coppage conducted production printing which included a 20-minute period of daily cleaning, cleaning of ink buckets conservatively estimated at twice a week for 2 hours each time, and general maintenance cleaning for a 2-day period twice a year. His daily average benzene exposure is calculated as 15.3 ppm.

News-American Apprentice 1965 – 1969

Based upon his description of his rotation as an apprentice, Mr. Coppage worked at the Baltimore News-American for a total of 16 months (1.3 years) during this period. Mr. Coppage conducted production printing which included a 20-minute period of daily cleaning, and general maintenance cleaning for a 2-day period twice a year. As he did not do the ink bucket cleaning at the News American, his daily average benzene exposure is calculated as:

$$\frac{5.1 \text{ ppm (5 days)} + 78 \text{ ppm (0.1 days)}}{5 \text{ days}}$$

$$= 6.7 \text{ ppm}$$

Alco-Gravure Apprentice 1965 – 1969

Based upon his description of his rotation as an apprentice, Mr. Coppage worked at Alco-Gravure for a total of 8 months (0.7 years) during this period. Mr. Coppage conducted production printing which included cleaning rollers at least twice a day to clear paper breaks (estimated at a 20-minute period daily) and general maintenance cleaning for a 3 to 4-day period once a year.

Using the benzene exposure levels for rotogravure printing in the 1960s as reported by Nise 1991, the average daily exposure level is 2.3 ppm. Factoring in the exposures from the daily press

cleaning, and the annual general maintenance cleaning, Mr. Coppage's average daily exposure at Alco-Gravure during this apprenticeship is:

$$\frac{2.3 \text{ ppm (374 min)} + 0.105 \text{ ppm (40 min)} + 0.105 \text{ ppm (6 minutes)}}{420 \text{ min}} \\ = 2.06 \text{ ppm}$$

Alco-Gravure Journeyman Pressman 1969 – 1998 (duration 29.5 years, in 3 of those years worked 60-80 hours per week so duration of exposure adjusted for this overtime is 32.5 years). Mr. Coppage conducted production printing which included a 20-minute period of daily cleaning as part of the process of clearing paper breaks, and general maintenance cleaning for a 3 to 4-day period once a year. Using the benzene exposure levels in the 1970s as reported by Nise 1991, the average daily exposure level is 0.15 ppm from 1971 to 1998. Factoring in the additional exposures from the daily press cleaning, and the annual general maintenance cleaning, Mr. Coppage's average daily exposure at Alco-Gravure during his employment is:

$$\frac{0.15 \text{ ppm (374 min)} + 0.105 \text{ ppm (40 min)} + 0.105 \text{ ppm (6 minutes)}}{420 \text{ min}} \\ = 0.14 \text{ ppm}$$

Baltimore Sun Journeyman Pressman 1999 – 2000 (duration 6 months, 0.5 years)

Mr. Coppage conducted production printing which included a 20-minute period of daily cleaning, cleaning of ink buckets conservatively estimated at twice a week for 2 hours each time. As he was only in this position for 6 months I did not factor in exposures from the annual general maintenance cleaning.

So, on days when he did ink bucket cleaning for a 2-hour period, Mr. Coppage's daily average benzene exposure (assuming 1 hour total unexposed for breaks and lunch) was

$$\frac{(0.105 \text{ ppm X 2 hours}) + (0.8 \text{ ppm X 5 hours}) + (0 \text{ ppm X 1 hour})}{8 \text{ hours}} \\ = 0.53 \text{ ppm as his daily time-weighted average benzene exposure.}$$

On days when he did the cleaning of the presses but not the ink buckets, his daily time-weighted average benzene exposure was

$$\frac{(0.105 \text{ ppm X 0.33 hours}) + (0.8 \text{ ppm X 6.67 hours}) + (0 \text{ ppm X 1 hour})}{8 \text{ hours}} \\ = 0.67 \text{ ppm}$$

His daily average benzene exposure is calculated as:

$$\frac{0.67 \text{ ppm (3 days)} + 0.53 \text{ ppm (2 days)}}{5 \text{ days}} \\ = 0.62 \text{ ppm}$$

Wall Street Journal Journeyman Pressman 1999 – 2000 (duration 6 months, 0.5 years)

Mr. Coppage conducted production printing which included a 20-minute period of daily cleaning. As he was only in this position for 6 months I did not factor in exposures from the annual general maintenance cleaning.

Since Mr. Coppage did the daily cleaning of the presses but not the ink buckets, his daily time-weighted average benzene exposure was

$$\frac{(0.105 \text{ ppm} \times 0.33 \text{ hours}) + (0.8 \text{ ppm} \times 6.67 \text{ hours}) + (0 \text{ ppm} \times 1 \text{ hour})}{8 \text{ hours}} \\ = 0.67 \text{ ppm}$$

Baltimore Sun Journeyman Pressman 2000 – 2006 (duration 6 years)

Mr. Coppage conducted production printing which included a 20-minute period of daily cleaning, and general maintenance cleaning for a 2-day period twice a year.

Since he did the daily cleaning of the presses but not the ink buckets, his daily time-weighted average benzene exposure was

$$\frac{(0.105 \text{ ppm} \times 0.33 \text{ hours}) + (0.8 \text{ ppm} \times 6.67 \text{ hours}) + (0 \text{ ppm} \times 1 \text{ hour})}{8 \text{ hours}} \\ = 0.67 \text{ ppm}$$

His daily average benzene exposure including the annual maintenance cleaning is calculated as:

$$\frac{0.67 \text{ ppm (5 days)} + 0.105 \text{ ppm (0.1 days)}}{5 \text{ days}} \\ = 0.67 \text{ ppm}$$

Table 10 Summary of Benzene Exposures by Work Location and Duration								
Employer	Job Title	Duration	Process	Production Including Daily Press Cleaning	Production Including Ink Bucket Cleaning (2 times/week)	Maintenance Cleaning (2 times/year)	Overall Daily Average Exposure (ppm)	Cumulative Benzene Exposure (ppm-years)
Baltimore Sun	Junior Pressman	1960-1965 (5 years)	Hoe letterpress	5.1 (3 days per week), 26.6 (2 days per week)	Yes	Yes	15.3	76.5
Boone Press Inc.	Junior Pressman	1961-1966	–	NR	NR	NR	–	–
Twentieth Century Printing Company	Junior Pressman	1963	–	NR	NR	NR	–	–
Baltimore Sun	Apprentice	1965 – 1969 (1.8 years)	Hoe letterpress	5.1 (3 days per week), 26.6 (2 days per week)	Yes	Yes	15.3	27.54
News-American	Apprentice	1965 – 1969 (1.3 years)	Goss letterpress	5.1 ppm	No	Yes	6.7	8.71
Alco-Gravure	Apprentice	1965 – 1969 (0.7 years)	Rotogravure	2.3 ppm	No	Yes	2.1	1.47
Alco-Gravure	Journeyman Pressman	1969 – 1998 (29.5 years adjusted to 32.5 accounting for overtime)	Rotogravure	0.15 ppm	No	Yes	0.14	4.55
Baltimore Sun	Journeyman Pressman	1999 – 2000 (0.5 years)	Goss offset press	0.62 ppm	Yes	No	0.62	0.31
Wall Street Journal	Journeyman Pressman	1999 – 2000 (0.5 years)	Goss offset press	0.67 ppm	Yes	No	0.67	0.34
Baltimore Sun	Journeyman Pressman	2000 – 2006 (6 years)	Goss offset press	0.62 ppm	Yes	Yes	0.62	3.72
ppm parts per million NR not reported								

Total sum cumulative benzene exposure is 123.14 ppm-years

Pumping Gasoline

For a period of two years, Mr. Coppage reported that he pumped gasoline into motor vehicles for approximately 40 hours per week. A range of benzene exposures from 0.024 to 3.2 ppm while pumping gasoline has been reported. If Mr. Coppage worked 8 hours per day pumping gasoline, at an exposure of 1.6 ppm for that period (midpoint of 0.024 and 3.2 ppm), his cumulative benzene exposure for that period would be daily average exposure would be 3.2 ppm-years.

CONCLUSIONS

In addition to the opinions expressed in this report, I have come to the following conclusions:

Baltimore Sun: during his employment as a Junior Pressman from 1960-1965, Mr. Coppage's cumulative benzene exposure was 76.5 ppm-years. Later when he worked there part-time as an apprentice 1965 – 1969 (1.8 years), his cumulative benzene exposure was 27.54 ppm-years. When he returned to the Sun and worked for 6 months as a Journeyman Pressman (1999 – 2000) his cumulative benzene exposure was 0.31 ppm years. In his final period of employment at the Baltimore Sun, he was a Journeyman Pressman from 2000 – 2006, his cumulative benzene exposure was 3.72 ppm-years.

I consider these to be underestimates of Mr. Coppage's total benzene exposure as I did not include the dermal benzene exposures he may have experienced. Mr. Coppage reported that he used rubberized gloves during his employment, however the degree of protection that gloves provide against skin contact with benzene depends on factors including the actual glove material, the thickness of the gloves, and the frequency at which they are changed. As none of this information was available in the record for Mr. Coppage, I did not attempt to quantify the extent to which dermal benzene exposure may have added to his total cumulative exposure.

Baltimore News-American: Mr. Coppage worked there part-time as an apprentice 1965 – 1969 (1.3 years), his cumulative benzene exposure was 8.71 ppm-years.

Alco-Gravure: Mr. Coppage worked there first as a part-time apprentice 1965 – 1969 (0.7 years), his cumulative benzene exposure was 1.47 ppm-years. He returned as a Journeyman Pressman and worked from 1969 – 1998 (29.5 years). As he reported that he worked up to 80 hours per week with overtime for 3 of those years, I adjusted his time of exposure to 32.5 years accounting for overtime. His cumulative benzene exposure for the employment at Alco-Gravure was 4.55 ppm-years.

Wall Street Journal: Mr. Coppage worked for 6 months as a Journeyman Pressman (1999 – 2000), his cumulative benzene exposure was 0.34 ppm years.

I hold these opinions and conclusions to a reasonable degree of scientific certainty. If additional information becomes available I reserve the right to modify, amend or supplement this report.



Robert F. Herrick, Sc.D., CIH, FAIHA

August 9, 2019

Appendix A Model Results

APPENDIX A

MODEL RESULTS



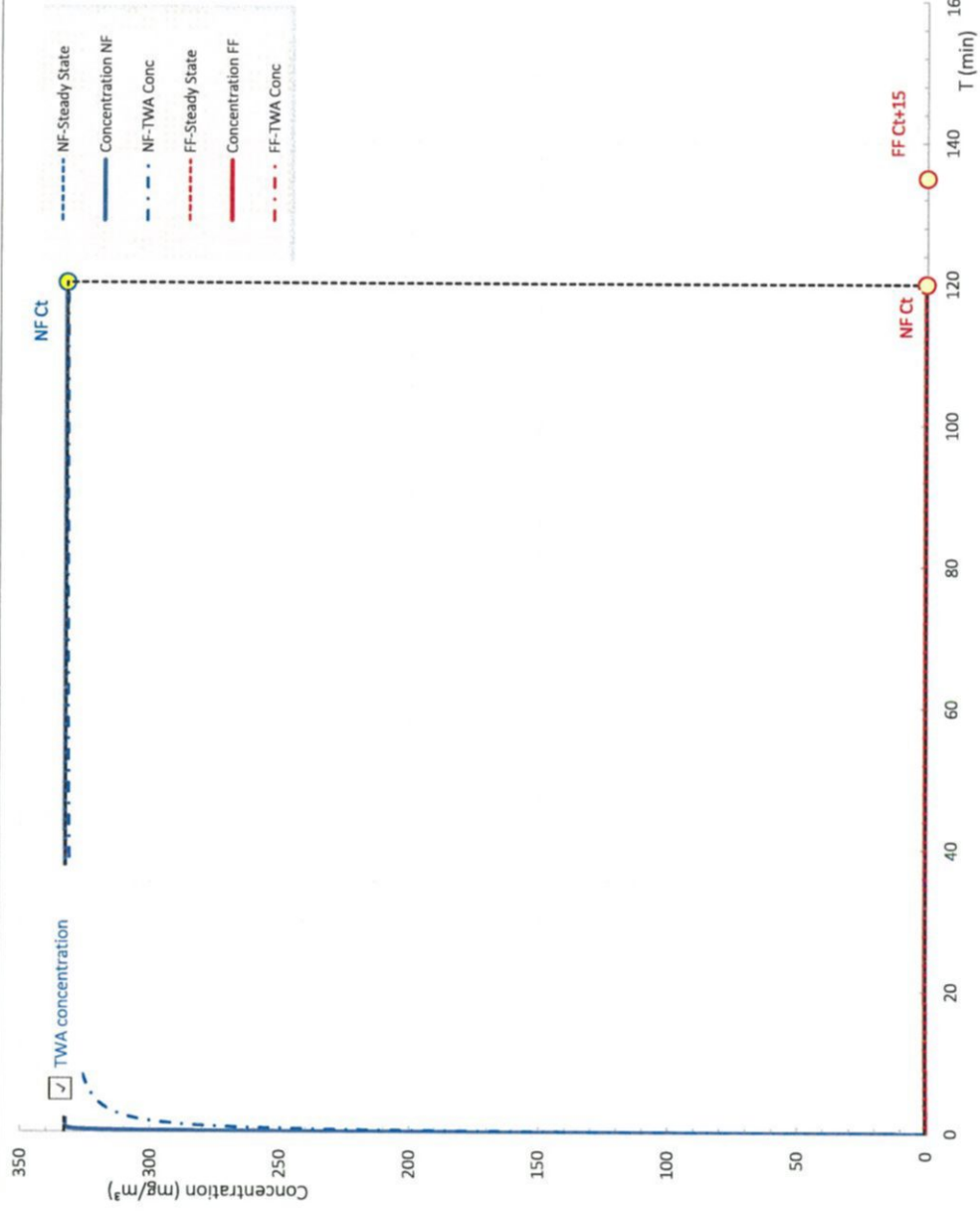
AIHA
Protecting Worker Health
Exposure Assessment
Strategies Committee

IH Mod 2.0

Two-Zone Model, Constant Emission

Model # 8aDeterministic

G	Contaminant mass emission rate	Maximum Value	Value
		3052 mg/min	3052 mg/min
Q	Room supply/exhaust air rate	6653 m³/min	6653 m³/min
S	Random Air Velocity	10 m/min	5.2 m/min
	Near field shape	Radius	0.75 m
	<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> $\beta = \frac{1}{2} \cdot FSA \cdot S$ </div> </div>	Free Surface area	3.53 m²
		β	9.18 m³/min
Vr	Room volume	79832 m³	79832 m³
Vnf	Volume Near Field	0.884 m³	0.884 m³
Vff	Volume Far Field	79831.116 m³	79831.116 m³
	Maximum time for simulation	120 min	t
	Time at the end of generation	120 min	120 min
	Ct	333 mg/m³	Pot. St. State
	Near Field	333 mg/m³	333 mg/m³
	Far Field	0.459 mg/m³	0.459 mg/m³
	Mass emitted to time t	366000 mg	
	See results		



$$C_{NF}(t) = \frac{G}{Q} + \frac{G}{\beta} \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + 0)}{\beta \cdot Q - V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_1 \cdot t) - \frac{G}{\beta} \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + 0)}{\beta \cdot Q - V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_2 \cdot t)$$

Version 2.002 : August 2018

This file has been created by Daniel Drolet and Tom Armstrong with review by Michael Jaylo

ck



IH Mod 2.0

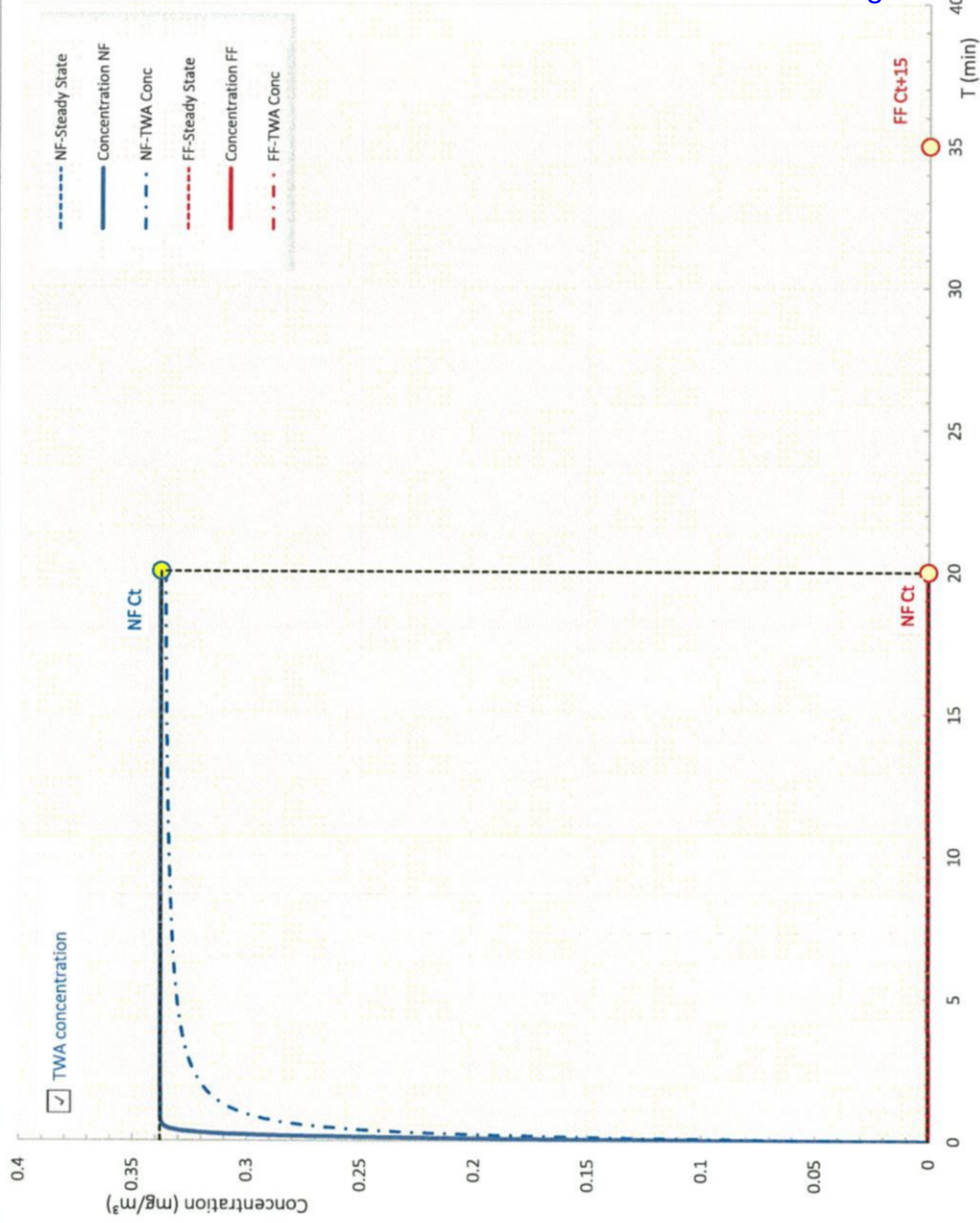
Two-Zone Model, Constant Emission

Model # 8aDeterministic

G	Contaminant mass emission rate	10 mg/min	Value	3.1 mg/min
Q	Room supply/exhaust air rate	6653 m³/min		6653 m³/min
S	Random Air Velocity	10 m/min		5.2 m/min
Near field shape		Radius 0.75 m		
<input checked="" type="radio"/> Sphere <input type="radio"/> 1/2 Sphere $\beta = \frac{1}{2} \cdot f_{SA} \cdot S$		Free Surface area	3.53 m²	β 9.18 m³/min
Vr	Room volume	79832 m³		79832 m³
Vnf	Volume Near Field	0.884 m³		0.884 m³
Vff	Volume Near Field	79831.116 m³		79831.116 m³
Maximum time for simulation		20 min		t 20 min
Time at the end of generation		20 min		
Ct		TWA, Ct to Ct+15	Pot. St. State	
Near Field	0.338 mg/m³	0.338 mg/m³	0.338 mg/m³	
Far Field	0.00038 mg/m³	0.00038 mg/m³	0.00047 mg/m³	
Mass emitted to time t		62 mg		

See results

Version 2.002 : August 2018

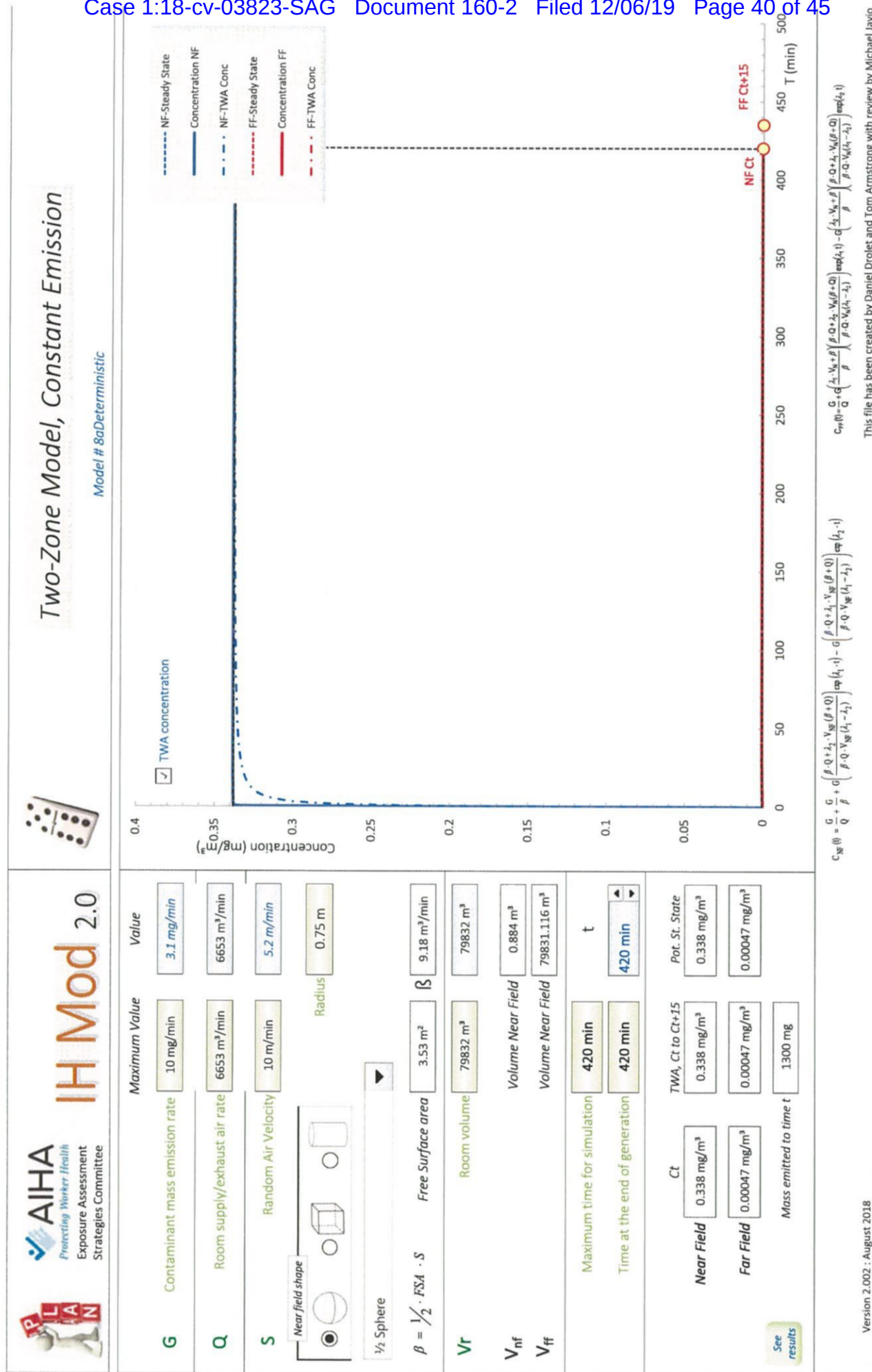


$$C_{NF}(t) = \frac{G}{Q} + \frac{G}{\beta} \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + Q)}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_1 \cdot t) - \frac{G}{\beta} \left(\frac{\lambda_1 \cdot V_{NF} + \beta}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_2 \cdot t)$$

$$C_{FF}(t) = \frac{G}{Q} + \frac{G}{\beta} \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + Q)}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_1 \cdot t) - \frac{G}{\beta} \left(\frac{\lambda_1 \cdot V_{NF} + \beta}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_2 \cdot t)$$

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IHMOD_2_0 (6)lactane 420 min - 8Ad

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IH Mod 2.0

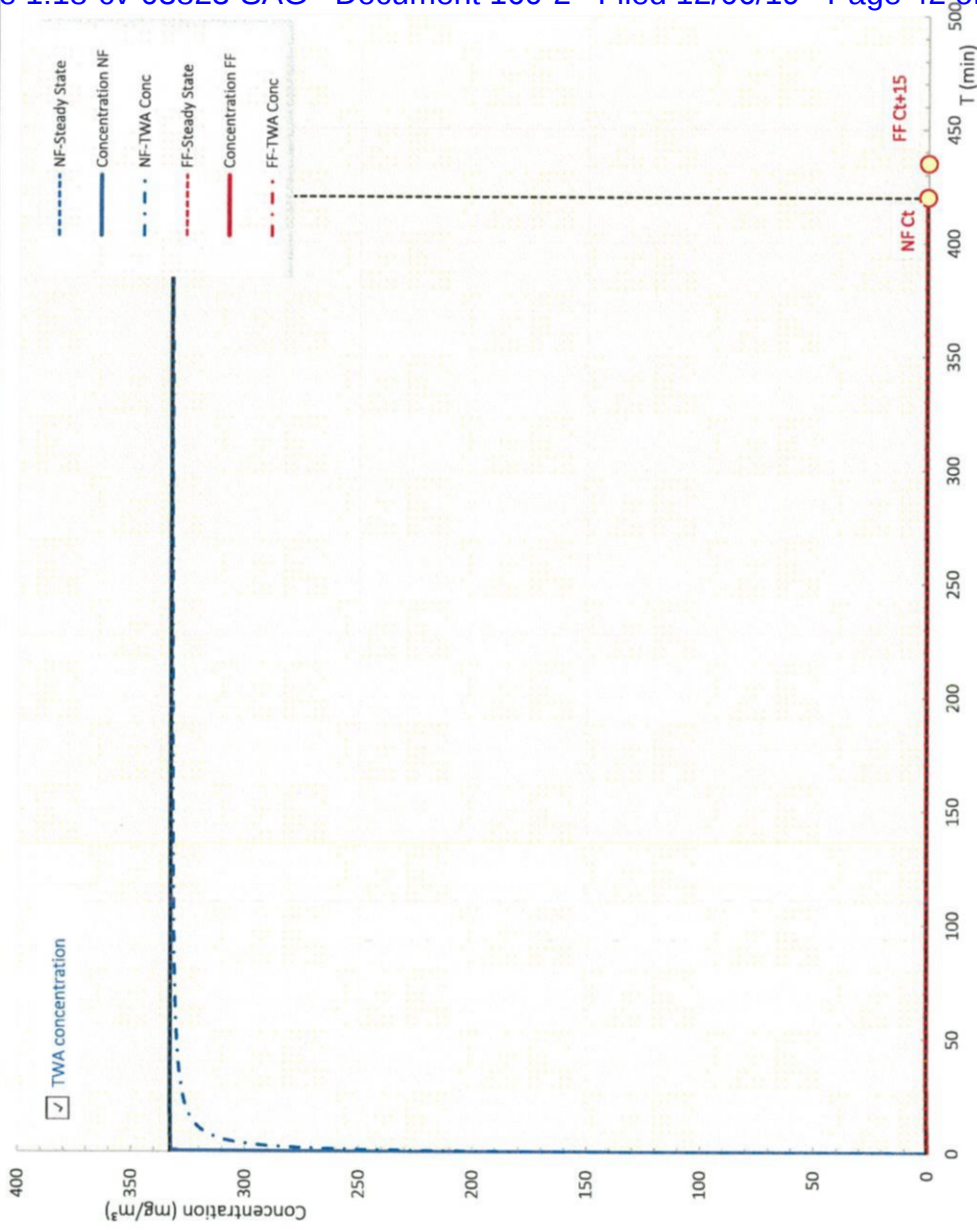
Two-Zone Model, Constant Emission

Model # 8aDeterministic

G	Contaminant mass emission rate	3052 mg/min	Maximum Value	Value	3052 mg/min
Q	Room supply/exhaust air rate	6653 m³/min			6653 m³/min
S	Random Air Velocity	10 m/min			5.2 m/min
	Near field shape			Radius	0.75 m
	$\beta = \frac{1}{2} \cdot fSA \cdot S$	Free Surface area	3.53 m²	β	9.18 m³/min
Vr	Room volume	79832 m³			79832 m³
Vnf	Volume Near Field	0.884 m³			0.884 m³
Vff	Volume Far Field	79831.116 m³			79831.116 m³
	Maximum time for simulation	420 min		t	420 min
	Time at the end of generation	420 min			
Ct	TWA, Ct to Ct+15	333 mg/m³	Pot. St. State		333 mg/m³
Near Field	333 mg/m³				
Far Field	0.459 mg/m³				0.459 mg/m³
	Mass emitted to time t	1280000 mg			

See results

Version 2.002 : August 2018



$$C_{NF}(t) = \frac{G}{Q} + \frac{G}{\beta} \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + Q)}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_1 \cdot t) - \frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + Q)}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \exp(\lambda_2 \cdot t)$$

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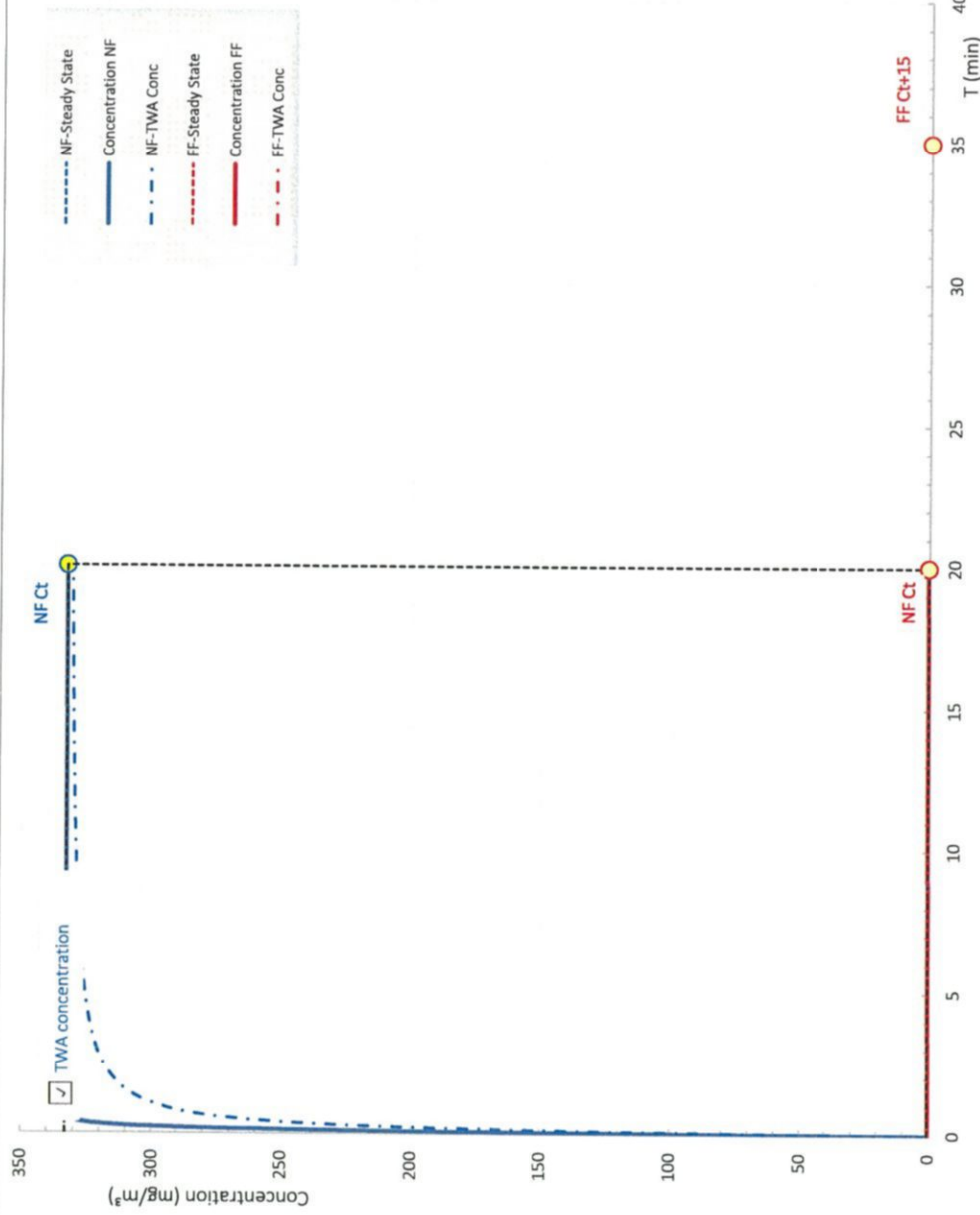
IH Mod 2.0

Two-Zone Model, Constant Emission

Model # 8aDeterministic

G	Contaminant mass emission rate	Maximum Value	Value
		3052 mg/min	3052 mg/min
Q	Room supply/exhaust air rate	6653 m³/min	6653 m³/min
S	Random Air Velocity	10 m/min	5.2 m/min
	Near field shape	Radius	0.75 m
	1/2 Sphere		
	$\beta = \frac{1}{2} \cdot FSA \cdot S$	Free Surface area	3.53 m²
Vr	Room volume	79832 m³	79832 m³
Vnf	Volume Near Field	0.884 m³	0.884 m³
Vff	Volume Far Field	79831.116 m³	79831.116 m³
	Maximum time for simulation	20 min	t
	Time at the end of generation	20 min	20 min
	Ct	TWA, Ct to Ct+15	Pot. St. State
	Near Field	333 mg/m³	333 mg/m³
	Far Field	0.371 mg/m³	0.459 mg/m³
	Mass emitted to time t	61000 mg	

See results



$$C_{NF}(t) = \frac{G}{Q} + \frac{G}{\beta} \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{NF}(\beta + 0)}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_1 \cdot t) - \frac{G}{\beta \cdot Q \cdot V_{NF}(\lambda_1 - \lambda_2)} \exp(\lambda_2 \cdot t)$$

$$C_{FF}(t) = \frac{G}{Q} + \frac{G}{\beta} \left(\frac{\beta \cdot Q + \lambda_1 \cdot V_{FF}(\beta + 0)}{\beta \cdot Q \cdot V_{FF}(\lambda_1 - \lambda_2)} \right) \exp(\lambda_1 \cdot t) - \frac{G}{\beta \cdot Q \cdot V_{FF}(\lambda_1 - \lambda_2)} \exp(\lambda_2 \cdot t)$$

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IHMOD_2_0 (6)surface clean 20 min - 8Ad

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